ARPA ORDER NO. 189-1

MEMORANDUM
RM-5015-ARPA
DECEMBER 1966

AD 646365

A DISPLAY SIMULATOR FOR COLORED-IMAGE PRESENTATION

R. H. Stratton

PREPARED FOR:
ADVANCED RESEARCH PROJECTS AGENCY

The RAND Corporation
SANTA MONICA • CALIFORNIA

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AMRA CR 66-05/7

AD 646 196

CENTER FOR HIGH ENERGY FORMING

SIXTH QUARTERLY REPORT

OF TECHNICAL PROGRESS

G. A. Thurston

January 1, 1967

U. S. Army Materials Research Agency
Watertown, Massachusetts 02172

Martin Company
A Division of Martin Marietta Corporation
Contract DA 19-066-AMC-266(X)
The University of Denver
Denver, Colorado

Sponsored by

Advanced Research Projects Agency

ARPA Order No. 720

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This research is supported by the Advanced Research Projects Agency under Contract No. SD-79. Any views or conclusions contained in this Memorandum should not be interpreted as representing the official opinion or policy of ARPA.

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PREFACE

This Memorandum describes the design concept of a display simulator. The purpose of the simulator is to present, on a viewing screen, one or more images whose individual size and shape, color and brightness, and position may be accurately controlled and varied with respect to real time. Such equipment could be used to advantage in many research efforts related to the psychophysics of color, color discrimination tests for radar observers, false color displays, etc.

A display simulator such as that described herein has been built by The RAND Corporation for an ARPA project dealing with human discrimination possibilities in missile defense systems.

SUMMARY

In connection with a study dealing with human discrimination possibilities in missile defense discrimination, it was decided to test the ability of human observers to discriminate color differences among widely spaced moving images. Before these color discrimination tests were conducted, it was necessary to develop the equipment for such visual presentations.

Several approaches to the design of this equipment were considered, and it was decided to use motion picture color photography, which seemed to be the most expedient method that satisfied the requirements of the discrimination tests. Equipment was developed to produce colored images on motion picture film by photographing a light source through several combinations of filters. Before an animation was filmed, the motion picture film was calibrated for color rendition, making it possible to produce the desired color on each film frame by means of different filter settings.

The display simulator provides the multiple images required for the discrimination tests, and permits close control over image parameters such as color and position. The range of the simulator's color capability with the present film and exposure technique is somewhat less than that detectable by the human visual system. However, as the image colors in the discrimination tests are of low saturation and grouped around white, this limitation is acceptable. Other applications of the display simulator might deman more saturated colors, which could be produced by changes in exposure technique or minor modifications to existing hardware.

The significance of the development of this hardware is that (1) display simulation equipment can be built to incorporate the use of subtractive color films, and (2) the physical specification of the colors can be accurately controlled by using reputable subtractive color films subject to consistency of manufacturing and processing.

ACKNOWLEDGMENTS

The writer wishes to express his appreciation to Dr. Carl Gazley for his many suggestions and constructive criticisms pertinent to the design of the equipment, and to Jeannine Lamar for her efforts in writing the computer program and reducing data for film calibration.

The writer also thanks George Dietrich for fabricating many of the individual pieces of hardware required, and David Stout for the electronic design of the regulated power supply.

CONTENTS

SYMBOLS*

$\left.\begin{matrix}x\\y\end{matrix}\right\}$ = CIE chromaticity coordinates

L = Luminosity, or fraction of luminous transmission to the CIE Standard Observer

λ = Wavelength of radiation, microns (or millimicrons)

3200°K tungsten = Spectral energy distribution of an incandescent tungsten lamp whose filament is at a temperature of 3200 deg Kelvin

T = Fraction of light transmission

D = Density = log 1/T

S = Spectral sensitivity = ergs/cm^2

E = Exposure = meter-candle-seconds

$\left.\begin{matrix}X\\Y\end{matrix}\right\}$ = Image location coordinates

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*Symbols pertinent to the FORTRAN computer program are listed in Table 1.

I. INTRODUCTION

False color displays making use of the color discrimination capability of a human observer have many applications. For instance, let us assume that we have several sources of radiation, such as ICBM warheads and decoys during atmospheric re-entry, each emitting infrared, radar return, and visible (optical) signals in various ratios. By the use of electro-optical-mechanical devices, each type of signal from a given source could be transformed into a characteristic color image, superimposed on the others, and displayed as a single color image. If the additive primaries red, green, and blue were used (the additive system is discussed in Section II), the color and brightness of the combined image for each re-entry body would depend on the strength ratio of the infrared, radar, and visible signals. Since the human visual system can discriminate subtle differences in color and brightness, small differences between these signal strengths might be readily visible on the display.

In the past, considerable research has been done on the human visual system to determine its color discrimination level when viewing a bipartite field,[(1)] but few investigations have been carried out to determine color discrimination capabilities with regard to widely separated, small moving images. In connection with an ARPA project, RAND has undertaken a series of color discrimination tests on human observers, using separated moving images. Before the completion of the display simulator, color discrimination tests using stationary images were performed on several observers.* The need to extend this testing program to include moving images was the impetus for building the display simulation hardware.

It is relatively easy to project a stationary image or spot of light of a specific color and brightness on a rear-projection surface. To accurately control changes of position, color, and brightness of one or more of these images on a display format with respect to time is somewhat more difficult. Three alternative methods were considered: First,

*This work will be reported in a forthcoming publication.

the use of three synchronized movie projectors with the red, green, and blue additive records of each image projected in superposition; second, the use of a color TV display with the red, green, and blue records pre-programmed on three-channel tape; and third, the exposure of a subtractive color movie film. The last method was chosen as the most satisfactory for our purposes. The first method requires the use of triple optics in both original photography and projection, and poses difficult image registration problems. The second requires a large amount of electronic equipment and would very likely produce a relatively poorly defined image.

A brief review of color specification and color systems is presented in Section II for the reader who may be unfamiliar with the physics and psychophysics of color. Section III deals with the theory of subtractive color films. A description of the theory of operation of the display simulator and a discussion of its important design features are given in Section IV. Section V describes the calibration of one specific type of color film for use with the simulator. The discussion in Section VI is largely an evaluation of the capabilities of the present hardware, with suggested improvements for possible future simulators.

A complete treatment of color specification, color systems, and the theory of subtractive color films is beyond the scope of this Memorandum, and is covered thoroughly in other writings; however, since the design of the simulator must take cognizance of various parameters pertinent to these three topics, particularly subtractive color films, some discussion of each is included.

II. COLOR SPECIFICATION AND COLOR SYSTEMS

The color and brightness of the images on the display screen of the simulator are specified in terms of the CIE Chromaticity Diagram,[2] which is shown in Fig. 1. This diagram was established by the International Commission on Illumination in 1931 as a standard graphical representation of the appearance of a color to the human visual system; it is based on the assumption that the appearance of any color may be defined by a certain ratio of the mixing of the red, green, and blue tristimulus values of a hypothetical standard observer.[3,4] This diagram is actually three-dimensional, as luminosity or brightness is on an axis normal to the plane of the page. The location of the visual color sensation is defined by x and y chromaticity coordinates. The achromatic or "white" point of the display simulator image is taken as 3200°K tungsten, which is a very close approximation of the color temperature of the lamp in the projection system; color and brightness of the display image are completely defined by the chromaticity coordinates x and y and luminosity L. The term 'luminosity' as used herein is the percent luminous transmission of the film image (including base density) to a 3200°K tungsten light source; the range of the visible spectrum is assumed to be from .38 to .76 microns. The determination of x, y, and L values is discussed in Section V.

There are two basic systems or methods of projecting a colored image, one additive and the other subtractive. The present display simulator uses positive color motion picture film and minus primary filters, both of which are instances of the subtractive system.

With the additive method, colored light from three separate sources, usually red, green, and blue, is projected in superposition on a highly reflective, spectrally nonselective or "white" surface. If the spectral energy distributions of the three light sources have been properly chosen, almost any color that the human eye is capable of sensing may be produced by mixing varying amounts of these colors, often referred to as the additive primaries.[5] It is possible to produce moving colored images with the additive method, but this would require a separate optical system for each of the three primaries, both in the original photography

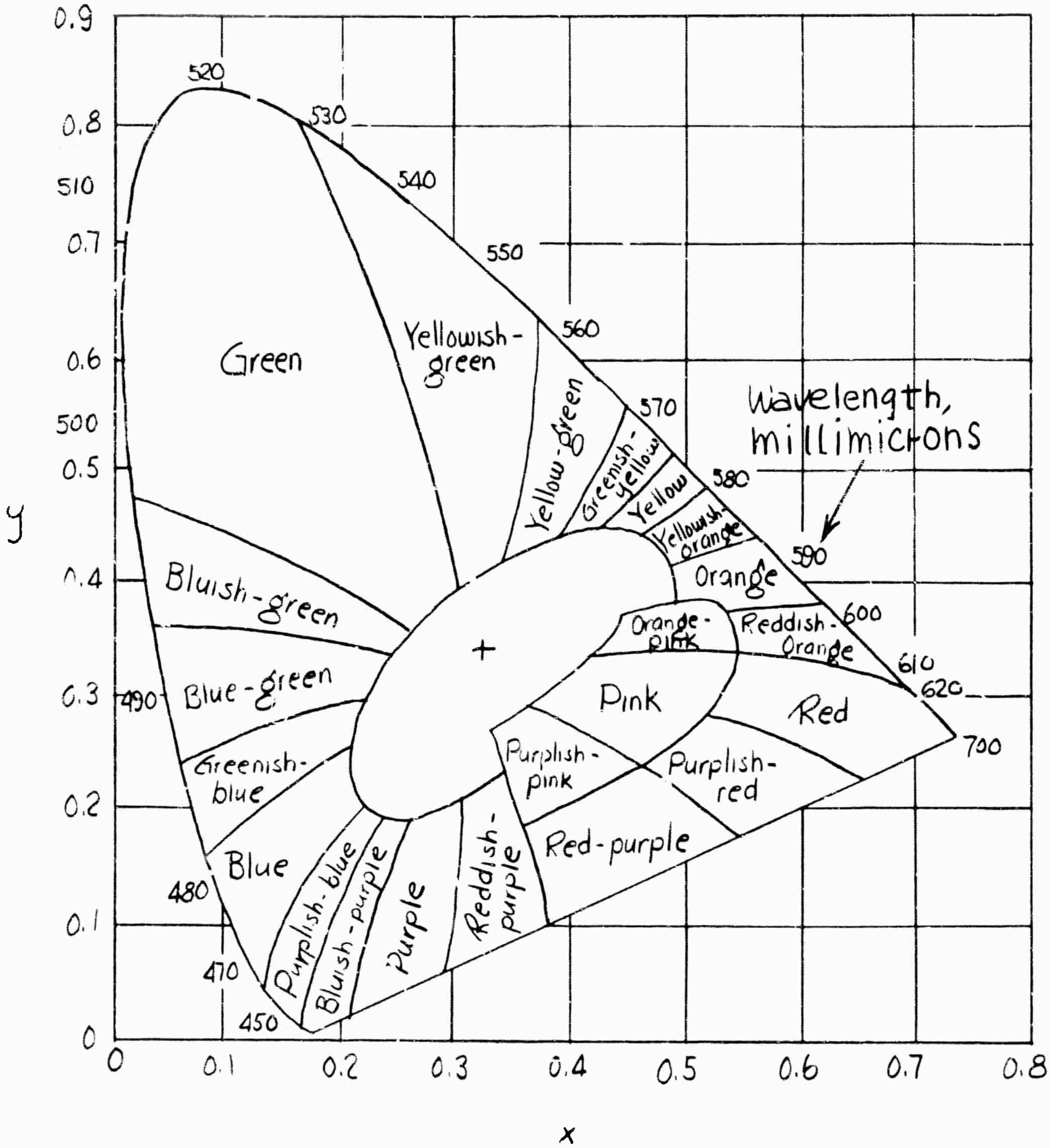


Fig. 1 -- Color regions of the CIE Chromaticity Diagram (adapted from Evans, 1948).

and in projection; the problem of image registration among the three optical systems becomes quite significant. The early history of color photography reveals many attempts at additive tricolor systems, some of which were moderately successful, but all of which employed bulky, complicated equipment.(6)

With the subtractive method, one "white" light is projected on a "white" surface, and the color of the projected spot is changed by using different combinations of filters placed in the light path. The hues of these filters are usually the complementaries of the additive primaries and are called cyan (minus red), magenta (minus green), and yellow (minus blue), usually called the subtractive primaries. By combining various densities of these three filters, a large gamut of visible colors can be produced.(5) Most positive subtractive color films currently manufactured use this method to render various colors with cyan, magenta, and yellow dye layers.(6) Because the dyes used in subtractive color films lack sharp-cutting transmission curves, their chromaticity gamut is generally smaller than that attainable with additive methods. However, the comparative simplicity of both camera and projection equipment outweighs this disadvantage, provided the limits of the required chromaticity gamut lie within the capability of the color film being used.

The subtractive system may be more easily understood by an examination of Fig. 2. Shown are the spectral transmission curves of typical magenta, yellow, and cyan dyes, which might be used as colorants in either color film or filters. Also shown are the resulting transmission curves when these dyes are combined two at a time to render red, green, and blue. The location of these colorants is indicated on the CIE Chromaticity Diagram either singly or in pairs, with a light source of approximately equal-energy distribution.

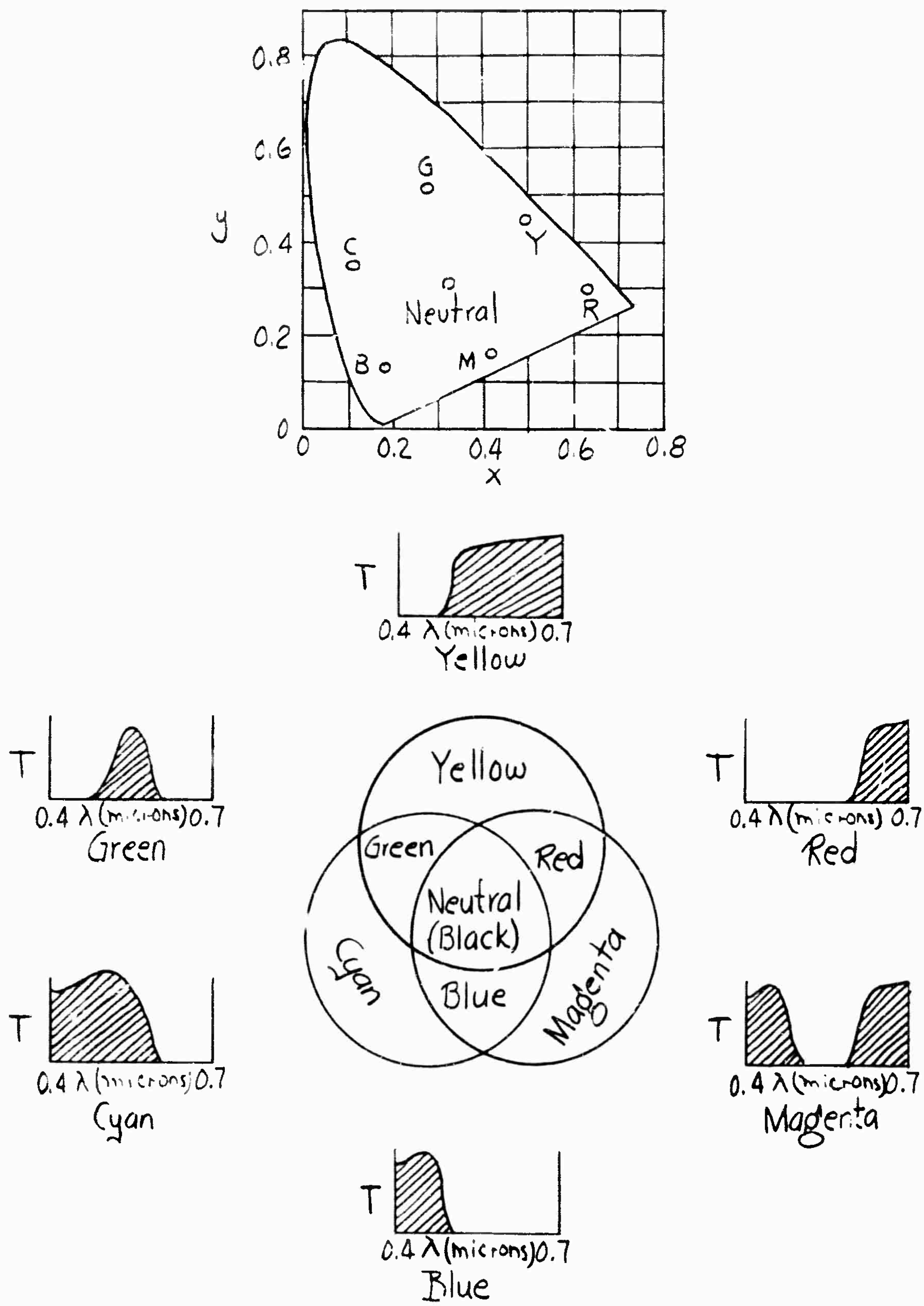


Fig. 2 -- Chromaticities and spectral transmissions of subtractive primaries and their combinations.

III. COLOR REPRODUCTION OF SUBTRACTIVE FILMS

CHROMATICITY

If an observer looks directly at a light source, he will see a color that is determined by the spectral energy distribution of the source, and which can be defined by CIE chromaticity coordinates. Should color film in a camera now be exposed to the same light at several different exposures, the resulting chromaticity coordinates of any of the processed film images when viewed by 3200°K tungsten light (or any other "white" light for that matter) will not, except by a rare coincidence, be the same as those of direct observation. Generally, chromaticity coordinates of the film image are closer to the achromatic point than those of direct observation, especially at low image densities. (The term 'density' as used in the photographic industry is defined as the negative log of transmission.) It is apparent that color film does not necessarily "see" color in exactly the same way as does the human observer.

FORMATION OF THE FILM IMAGE

Shown in the upper portion of Fig. 3 is a cross section of a typical subtractive color film before processing. Located next to the film support is the red-sensitive layer, next is the green-sensitive layer, and the blue-sensitive layer is on the outside. Between the green- and blue-sensitive layers is a yellow filter layer to prevent blue light from striking the red- and green-sensitive layers, as they are also sensitive to blue light. Theoretically, when a film is exposed to light of some spectral distribution, the processed film image will contain cyan, magenta, and yellow dyes whose densities vary inversely to the respective amounts of red, green, and blue light in the original exposure. Imagine that the film is now exposed to green light; the processed film cross-section would look like that in the lower portion of Fig. 3, with the density of the magenta dye reduced more than the other two dyes. The image on the film now appears green, since the red and blue components of the viewing illuminant are absorbed by the yellow and cyan dyes.

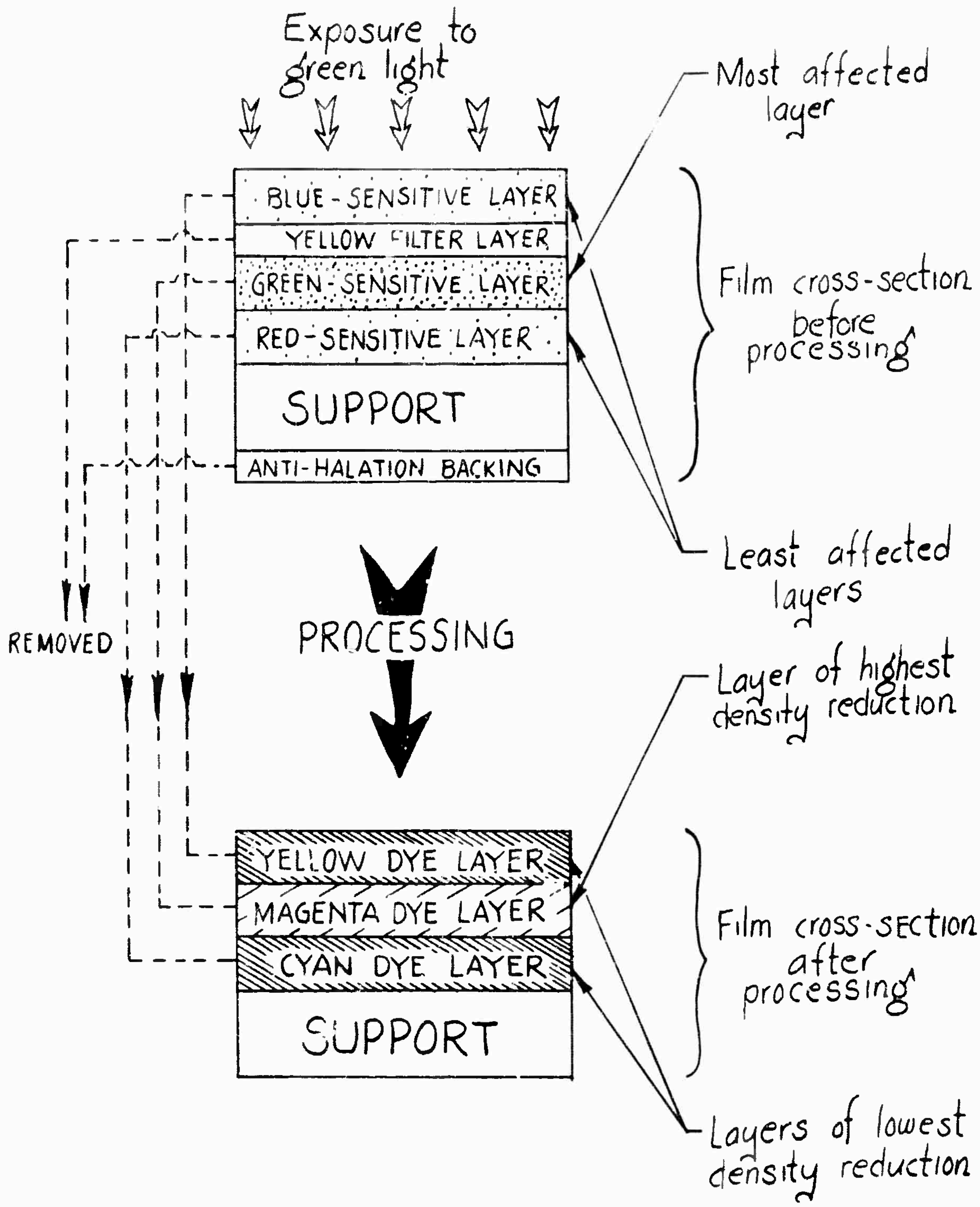


Fig. 3 -- Exposure of a typical subtractive color film to green light.

In the processing, the first (black-and-white) development produces in each layer a negative silver image whose density is proportional to the amount of exposure in that layer. The remaining silver halide is then fogged by a reversal exposure to render it developable.[7] From this remaining silver halide a positive dye image and a positive silver image are produced in each of the three layers by a coupler color development process. Both positive and negative silver images are then removed by a bleaching process, leaving only the three dye images.

SPECTRAL DENSITY AND SPECTRAL SENSITIVITY

Let us assume that we have an ideal hypothetical subtractive color film. Like real films, it would have three dye layers: magenta, yellow, and cyan. The shape of the spectral density curves of these three dyes might resemble those shown in Fig. 4; these are nearly "block" dyes, which do not exist in reality. As in real films, the exposure of our hypothetical film to light would reduce the dye image densities, but the spectral sensitivities of the three layers would overlap in such a way that their sum would be nearly the same at any wavelength. Our hypothetical film would then yield highly saturated or pure[5] colors even at low dye densities because of the sharp-cutting dye density curves, and chromaticity changes of the film image should follow chromaticity changes of the exposure light. Real color films do not work this way; their dyes do not have sharp-cutting spectral density curves and transmit some light in unwanted portions of the spectrum. Figure 5 shows the shape of the spectral density curves of the three dyes in a typical real color film. Also, the spectral sensitivities of the three dye layers in real films overlap in such a manner that the film is quite insensitive to color changes in the high end of the visible spectrum, whereas all three dye layers are sensitive in a band about .07 microns wide near the middle of the spectrum, and the sums of their spectral sensitivities can vary as mu [illegible] 300 to 1 over the visible region. Spectral sensitivity curves of the three dye layers of a typical real color film are shown in Fig. 6, and spectral sensitivity curves of our hypothetical color film might resemble those of Fig. 7. Spectral

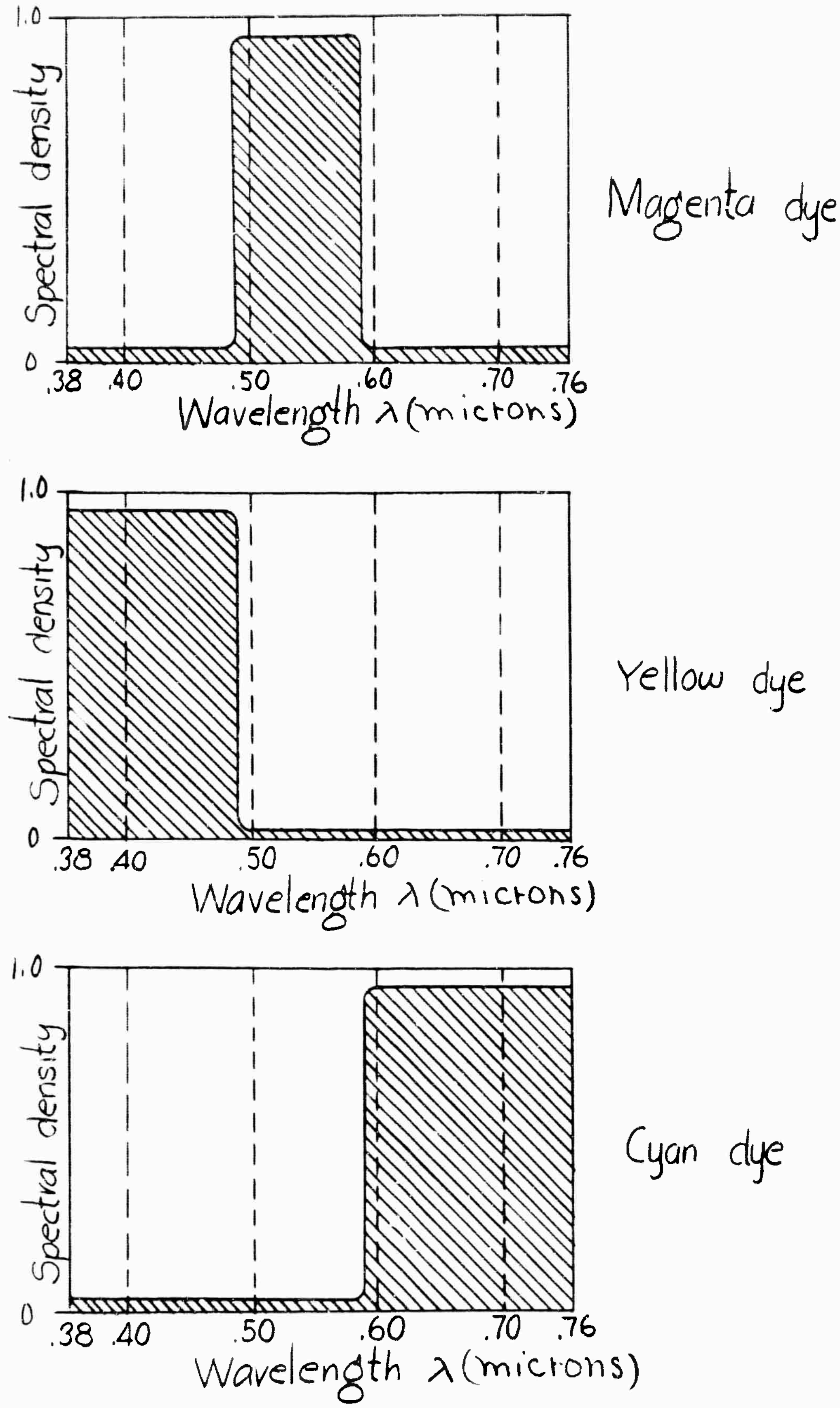


Fig. 4 -- Spectral dye densities of a hypothetical su.tractive color film.

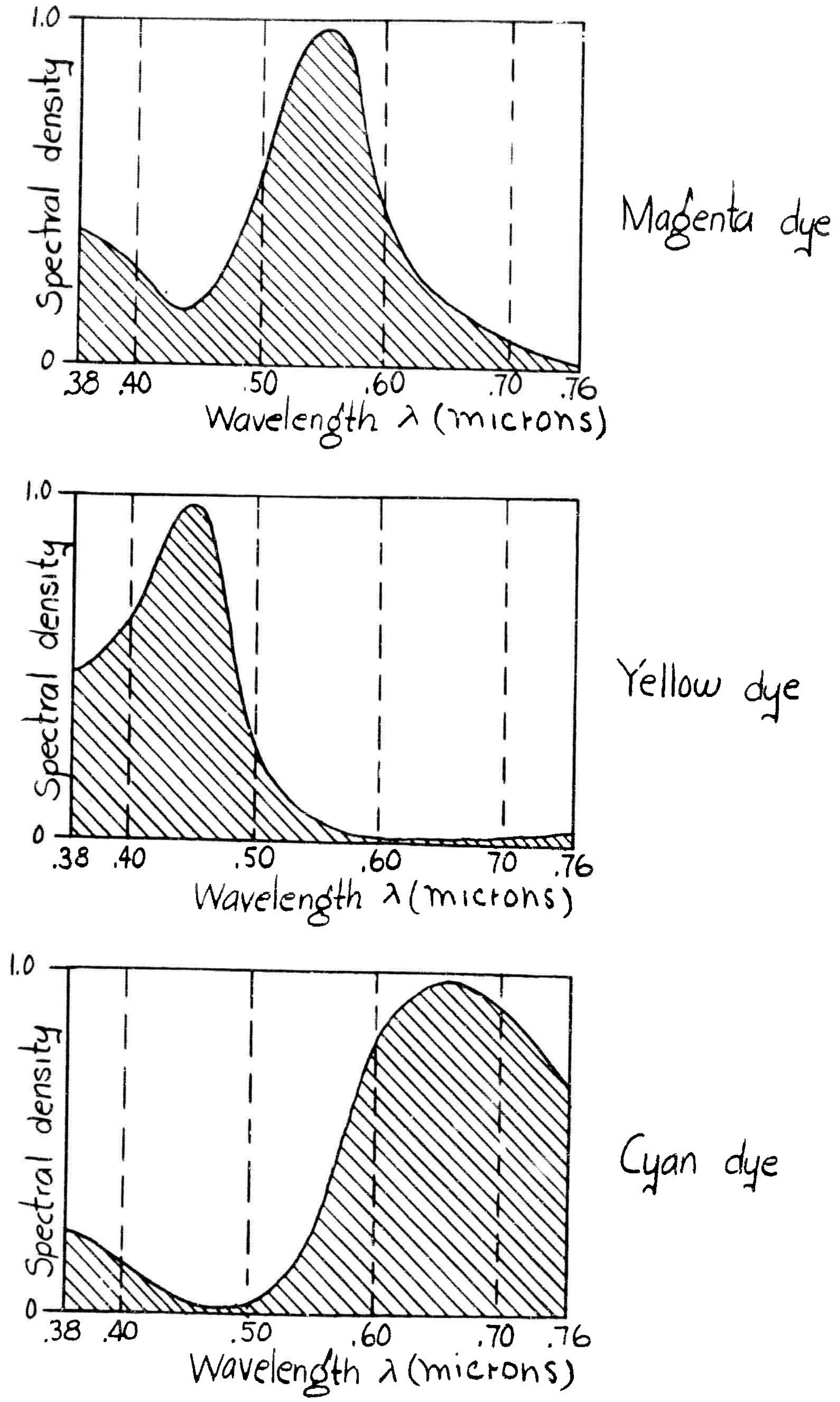


Fig. 5 -- Spectral dye densities of a typical real subtractive color film.

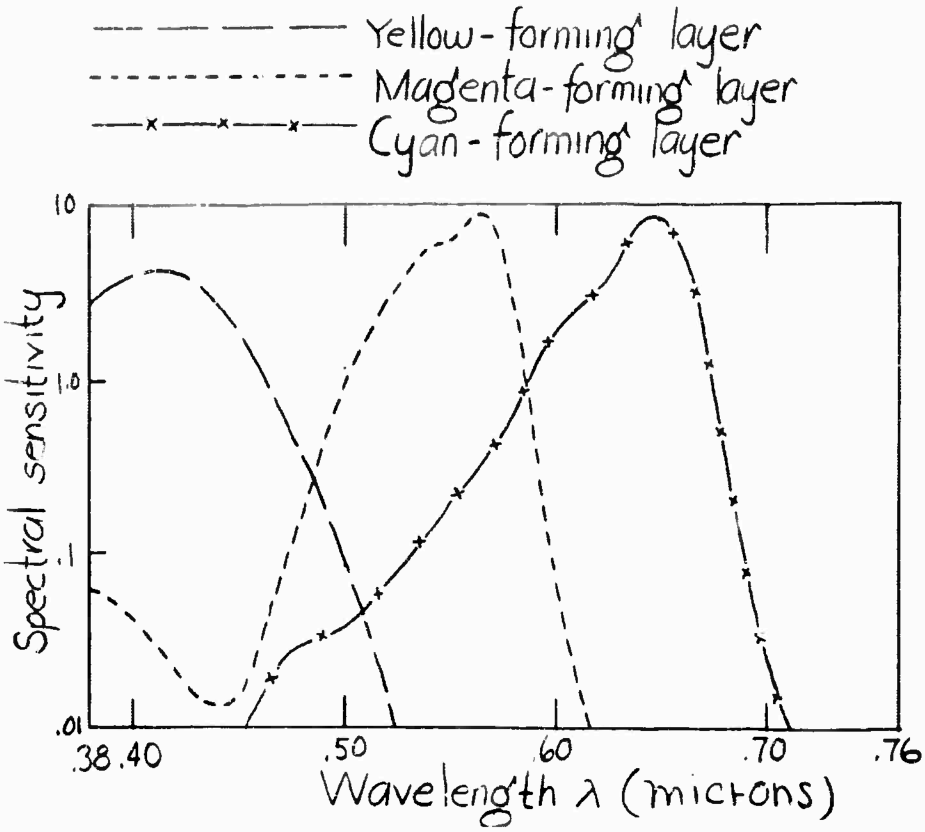


Fig. 6 -- Spectral sensitivities of a typical subtractive color film.

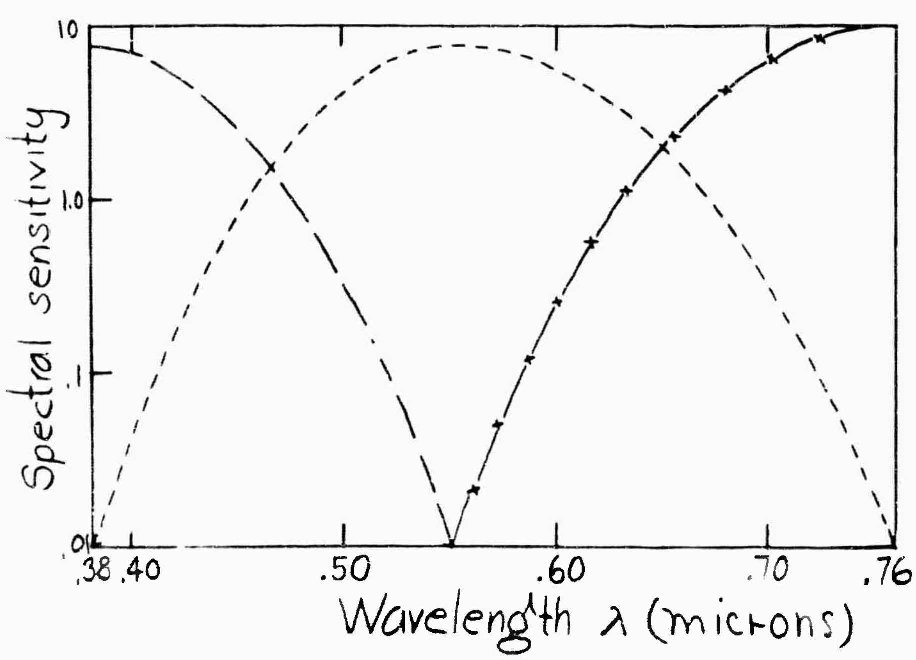


Fig. 7 -- Spectral sensitivities of a hypothetical subtractive color film.

sensitivity is the amount of incident energy of monochromatic radiation per unit area of film (ergs/cm^2) at wavelength λ_1 required to reduce the dye image density in the individual layer to some value at wavelength λ_2, or to some value of equivalent neutral density; λ_2 is often taken as the wavelength of peak density. Equivalent neutral density is the density of the visual neutral that is formed by the dye sample when sufficient amounts of the other two dyes are added to it.[8] Spectral sensitivity curves supplied by film manufacturers are valid for only one value of peak density or one value of equivalent neutral density, because spectral sensitivity itself is a function of the amount of incident energy. Such sensitivity data have little meaning except perhaps in quality control for film manufacture, since each set of curves is valid for only one specific density.

D LOG E CURVES

In the photographic industry, film density D is generally expressed as a function of the log exposure E. Somewhat more useful than the monochromatic spectral sensitivity curves are D log E curves for each of the three dye images. These curves express the density at either some specific wavelength or the equivalent neutral density of each of the three dye images as a function of the log of exposure to a light source of known spectral distribution. The D log E curves shown in Fig. 8 are for a typical real color film exposed to some standard white light source, such as 6100°K. Again, however, these data supplied by film manufacturers are of little use in calculating the resulting dye image densities when the film is exposed to light of some other spectral distribution.

From the foregoing it is evident that it would be absurd to attempt to compute, from data supplied by film manufacturers, the required spectral distribution and exposure of the film for any desired film image chromaticity. The obvious alternative is a film calibration that relates many different spectral distribution and exposure combinations to the resulting chromaticity of the processed film image; Section V deals with this calibration.

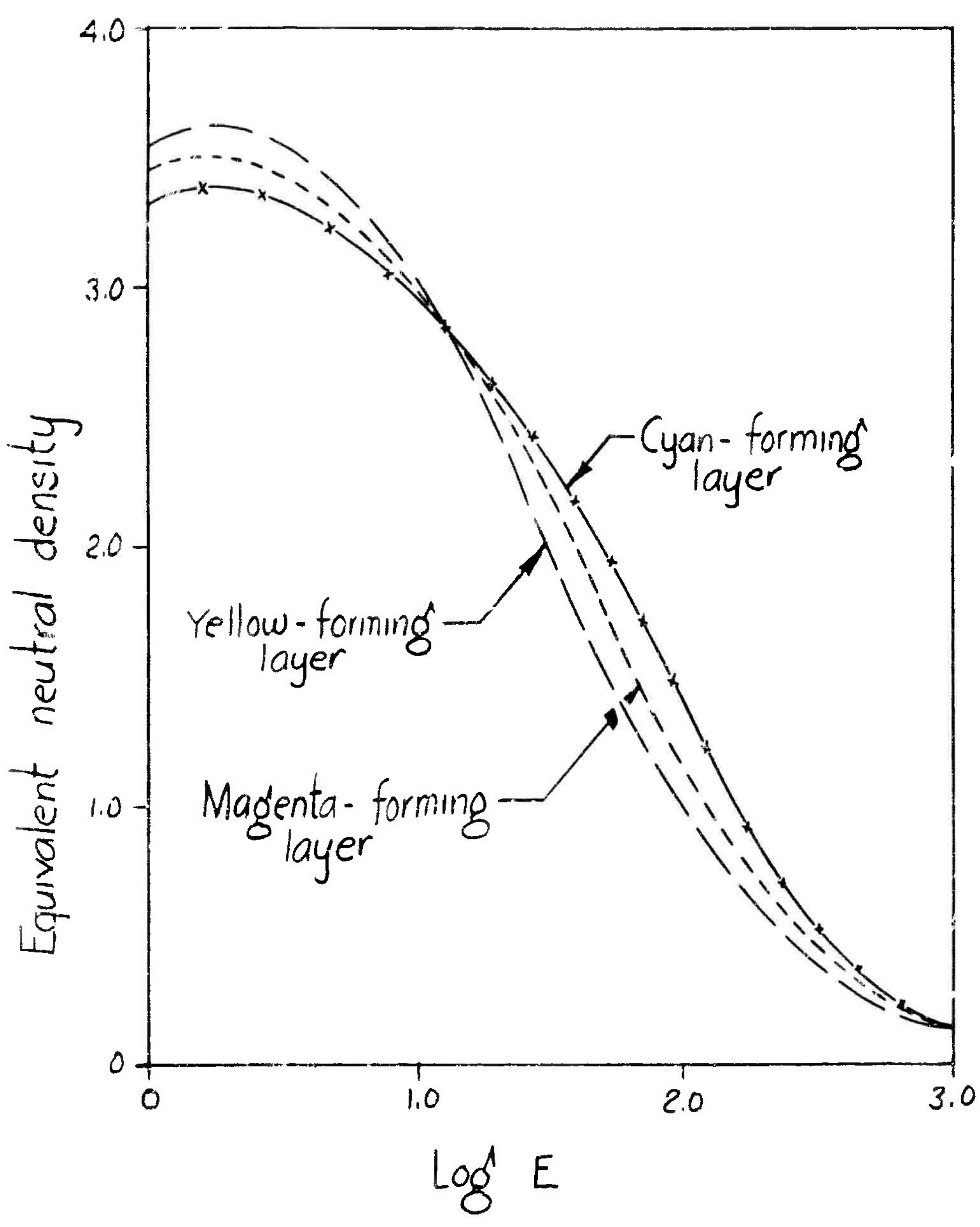


Fig. 8 -- D log E curves for typical subtractive color film exposed to a 6100°K artificial daylight source.

IV. DESIGN AND THEORY OF OPERATION

A schematic of the display simulator is shown in Fig. 9. The equipment consists of three main pieces or groups of hardware: animation stand, light source power supply, and projection system.

ANIMATION STAND

The animation stand is the most significant component of the simulator, and is shown in the photograph of Fig. 10. This piece of equipment is used to expose the display images on 16-mm color motion-picture film. The camera, a 16-mm Bolex H16 with a 25-mm f/1.4 lens, is attached, with its optical axis vertical, to a carriage assembly whose height is adjustable by means of a lead screw. The carriage assembly is fitted with V-groove rollers that ride on a vertical rail assembly; intimate contact between rollers and rails is maintained by the weight of the carriage assembly and camera. An underside photograph of the carriage assembly and camera is shown in Fig. 11. The vertical rail assembly is bolted to a horizontal base plate, which also supports the stage assembly beneath the camera. The stage assembly can be moved on two horizontal axes (X and Y) beneath the camera; its purpose is to control the location of the image being photographed on the 16-mm film format, and hence image location on the final display format. The stage assembly is moved with two lead screws coupled directly to revolution counters that indicate X and Y coordinates of the film image within the format. (Note: X and Y image location is not to be confused with x and y CIE chromaticity coordinates.) In addition to the X-Y positioning hardware, the stage assembly consists of: a light source and its enclosure, four wedge filters and their housing above the light source, an opal diffusing glass with aperture plate on the top side of the wedge filter housing, and a cover disc to prevent stray light from entering the camera. These components of the stage assembly are shown in the photograph of Fig. 12, with the cover disc removed.

The light source is a 900-volt xenon flashtube designed primarily for color photography with daylight color films; its maximum rated

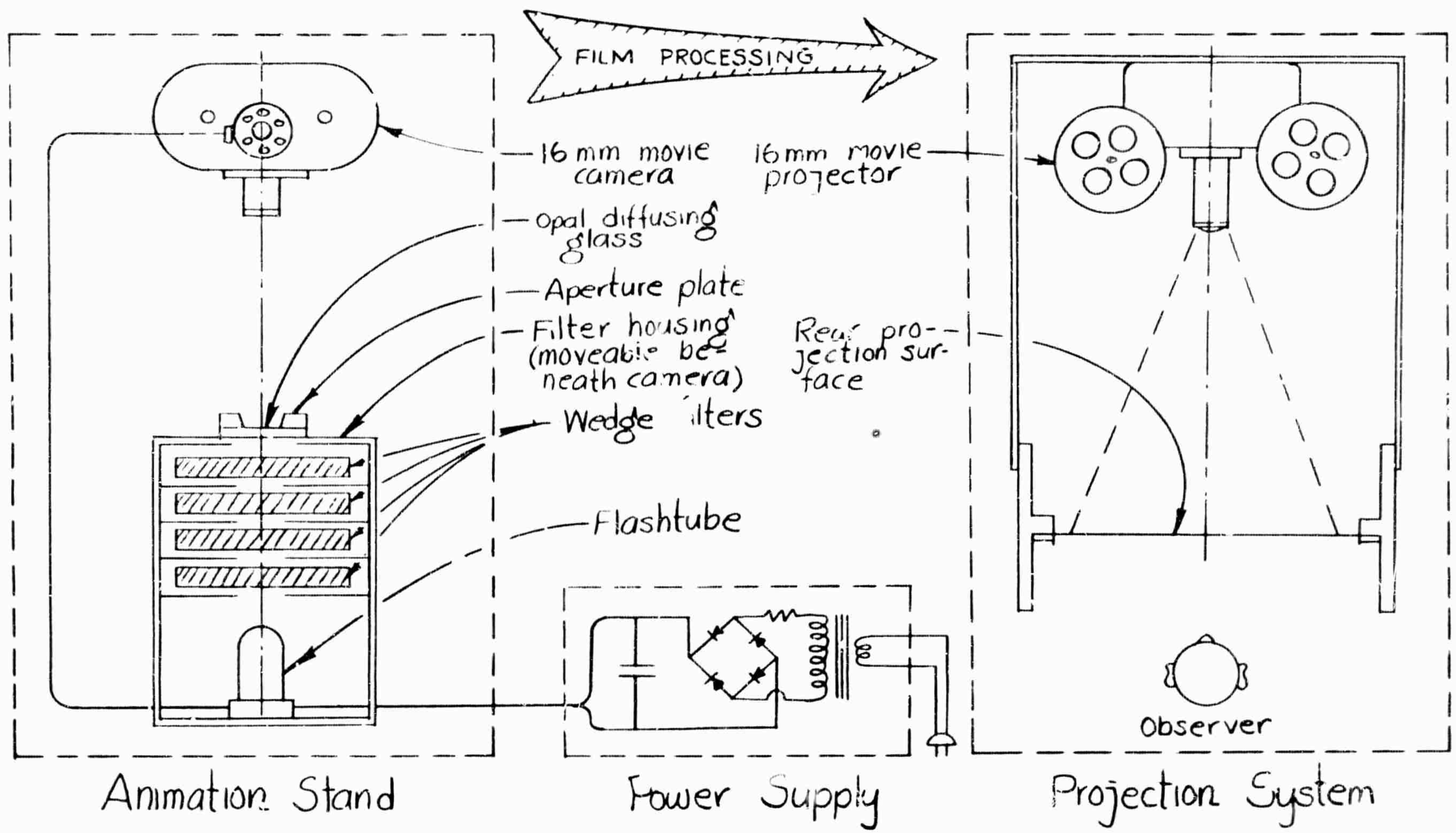


Fig. 9 -- Display Simulator Schematic.

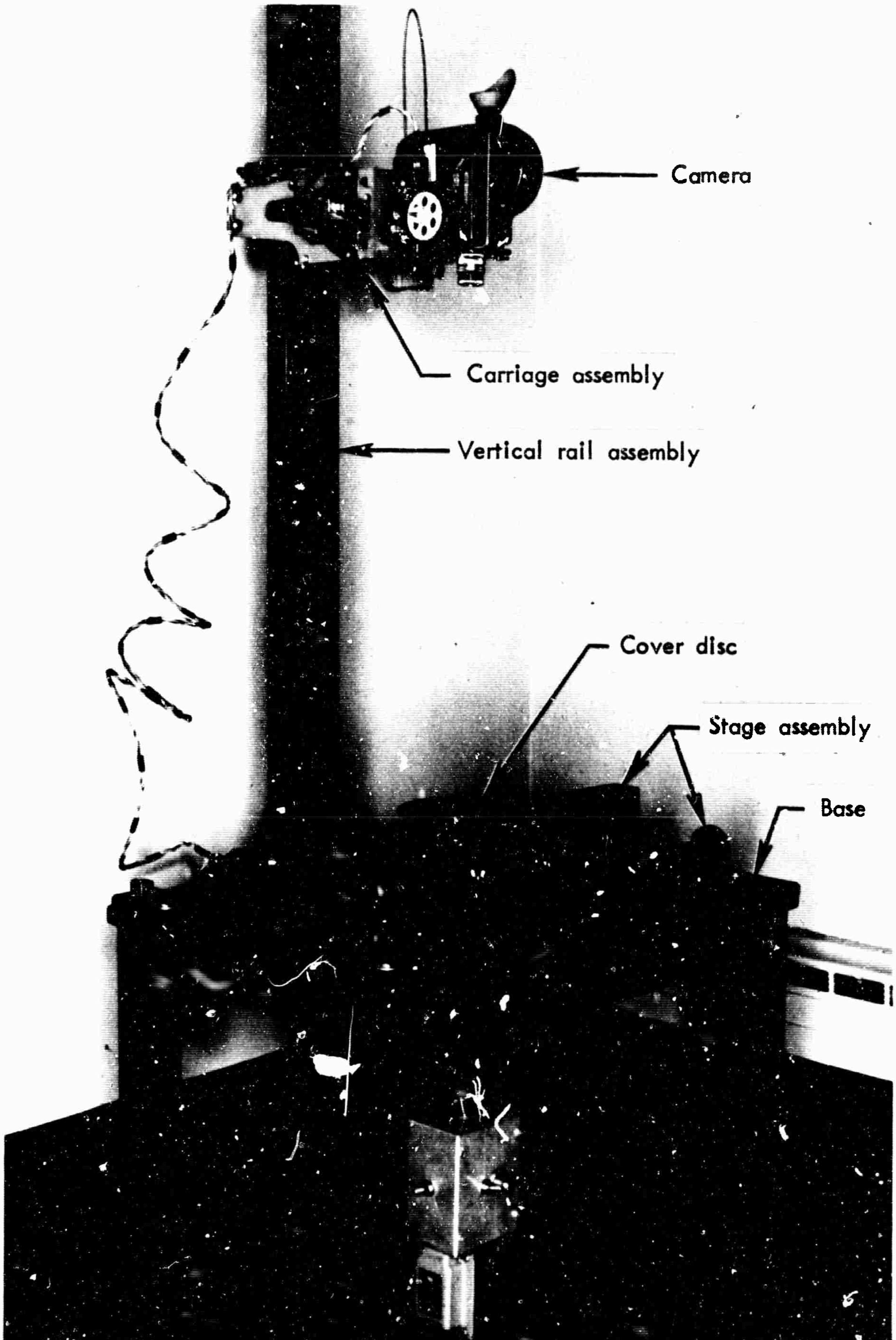


Fig. 10 -- Animation Stand

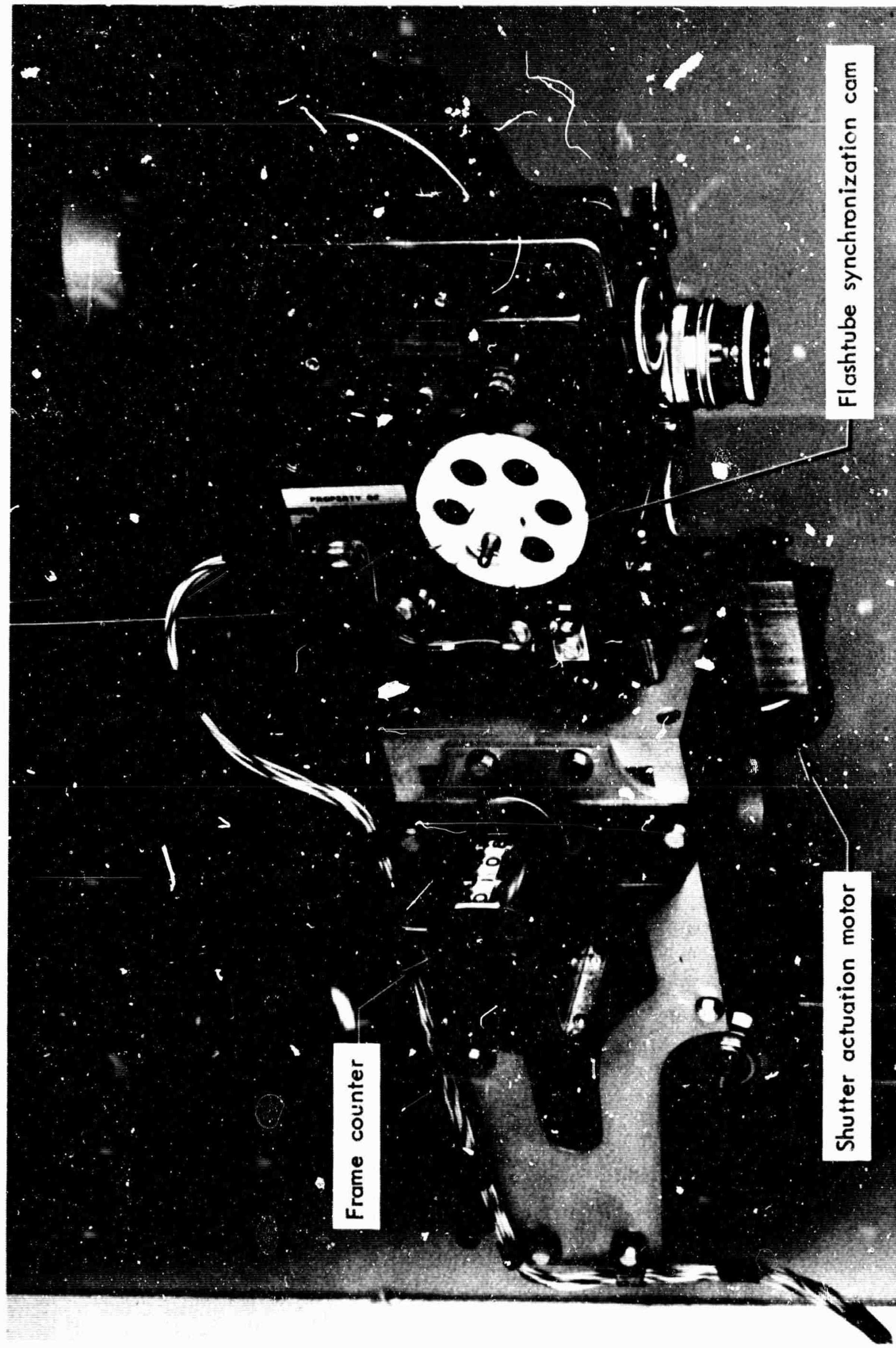


Fig. 11 -- Carriage Assembly

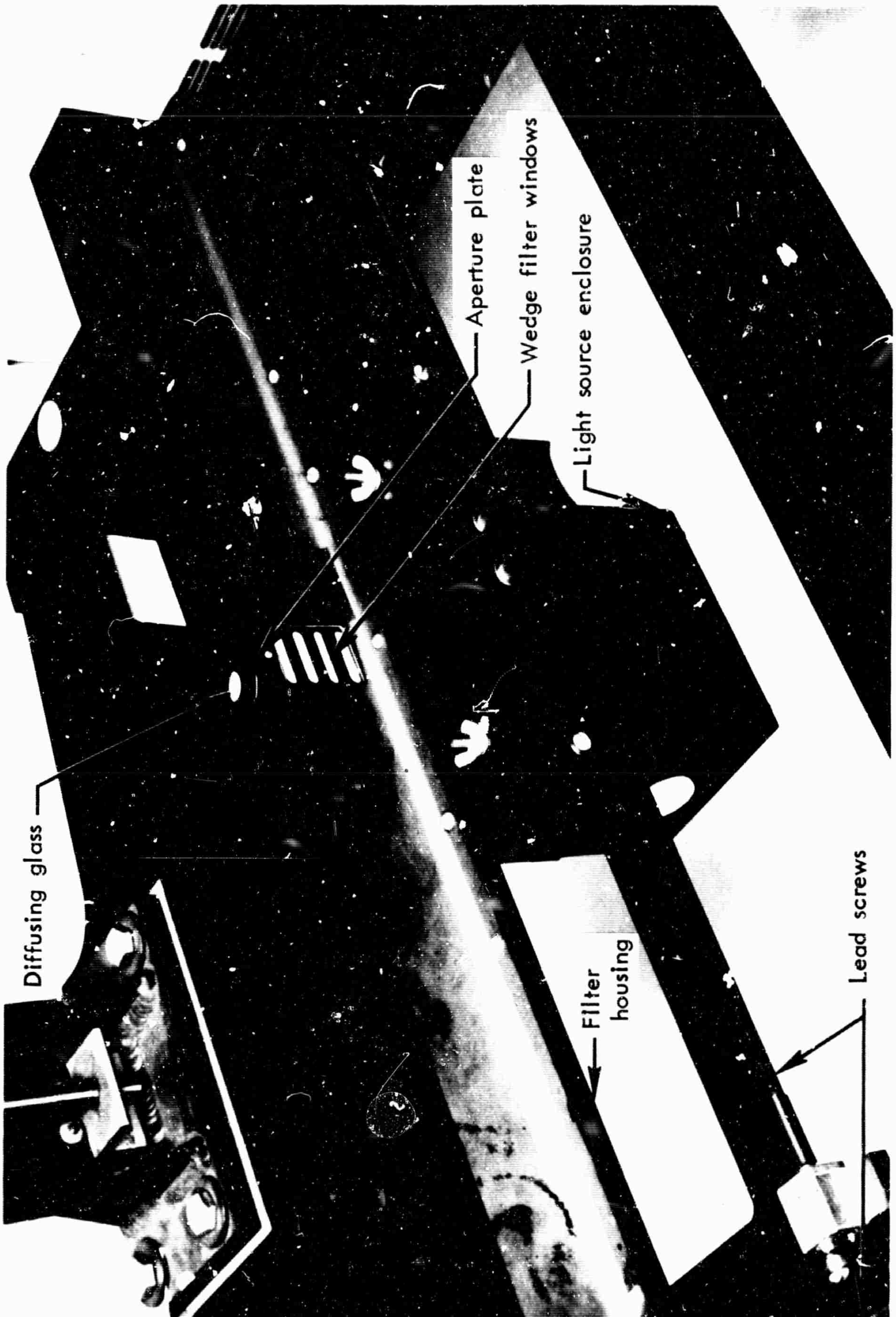


Fig. 12 -- Stage Assembly

input power is 200 watt-seconds per flash (GE FT-217). To extend its life, the flashtube is operated at only about 100 watt-seconds per flash. Light output and spectral distribution of a flashtube change little during its lifetime.[8] The flashtube and its trigger circuitry are enclosed in a light-tight housing, which is attached to the stage assembly with wing-nuts for quick removal. The photograph of Fig. 13 shows the flashtube and housing removed from the stage assembly.

The four wedge filters are located one above another in the filter housing. Each of these filters is of nearly constant hue, but has a density increase with length. The hues of the three colored filters are magenta, yellow, and cyan; the fourth is neutral. As there are three continuous wedge filters for each of the three subtractive hues, and one neutral filter, the entire set comprises ten filters. Three short wedges were used in preference to one long wedge for mechanical convenience; the dye densities of the middle wedge in each hue set slightly overlap the other two filters of the same hue, so there are no "gaps." Each wedge filter is provided with a lengthwise scale running from zero to approximately 29.4 cm, with the zero point of the scale at the light end of the wedge. Wedges in each hue set are designated 1, 2, and 3, beginning with the lightest wedge. For example, 14.7 Y2 refers to point on the second yellow wedge that has a scale reading of 14.7 cm. Typical spectral transmission curves of the wedge filters are shown in Fig. 14; more complete spectral transmission data are included in the Appendix. The photograph of Fig. 15 shows the set of wedge filters. By means of grooves within the filter housing, these wedge filters may be moved separately in a direction normal to the optical axis of the camera. Since light from the source passes through all four filters, both the color (spectral distribution) and intensity seen by the camera may be varied by small increments by using different combinations of filter positions, and hence different portions of each filter. The purpose of the neutral wedge is to control light intensities more accurately than is possible between the detented camera f/stops. Baffle plates with on-axis apertures are used between filters to reduce scattered light and restrict the light path to a small portion of each filter. The flashed opal diffusing glass between the wedge filters

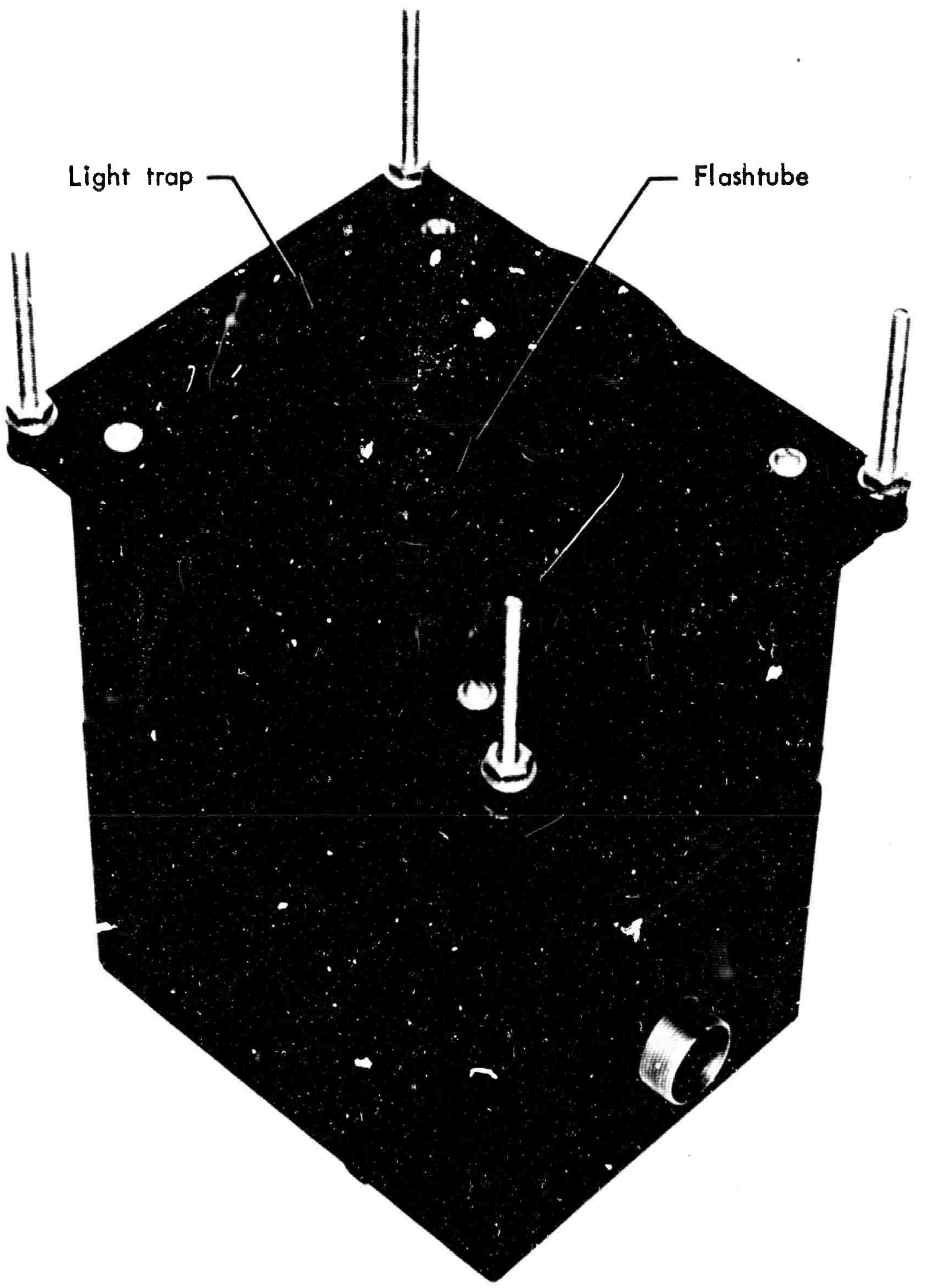


Fig. 13 -- Flashtube Housing

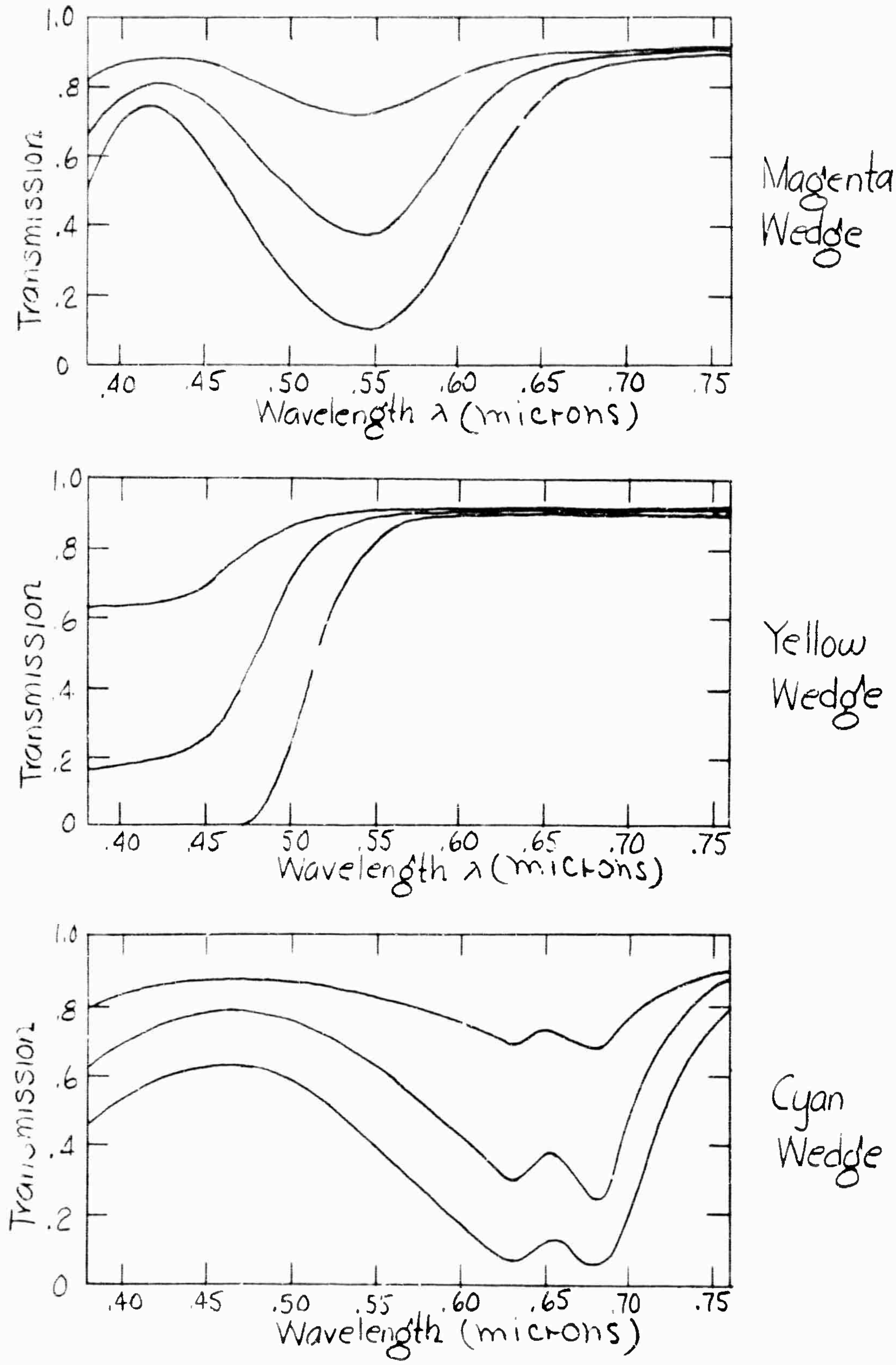


Fig. 14 -- Typical spectral transmission curves of wedge filters at three positions along the wedge.

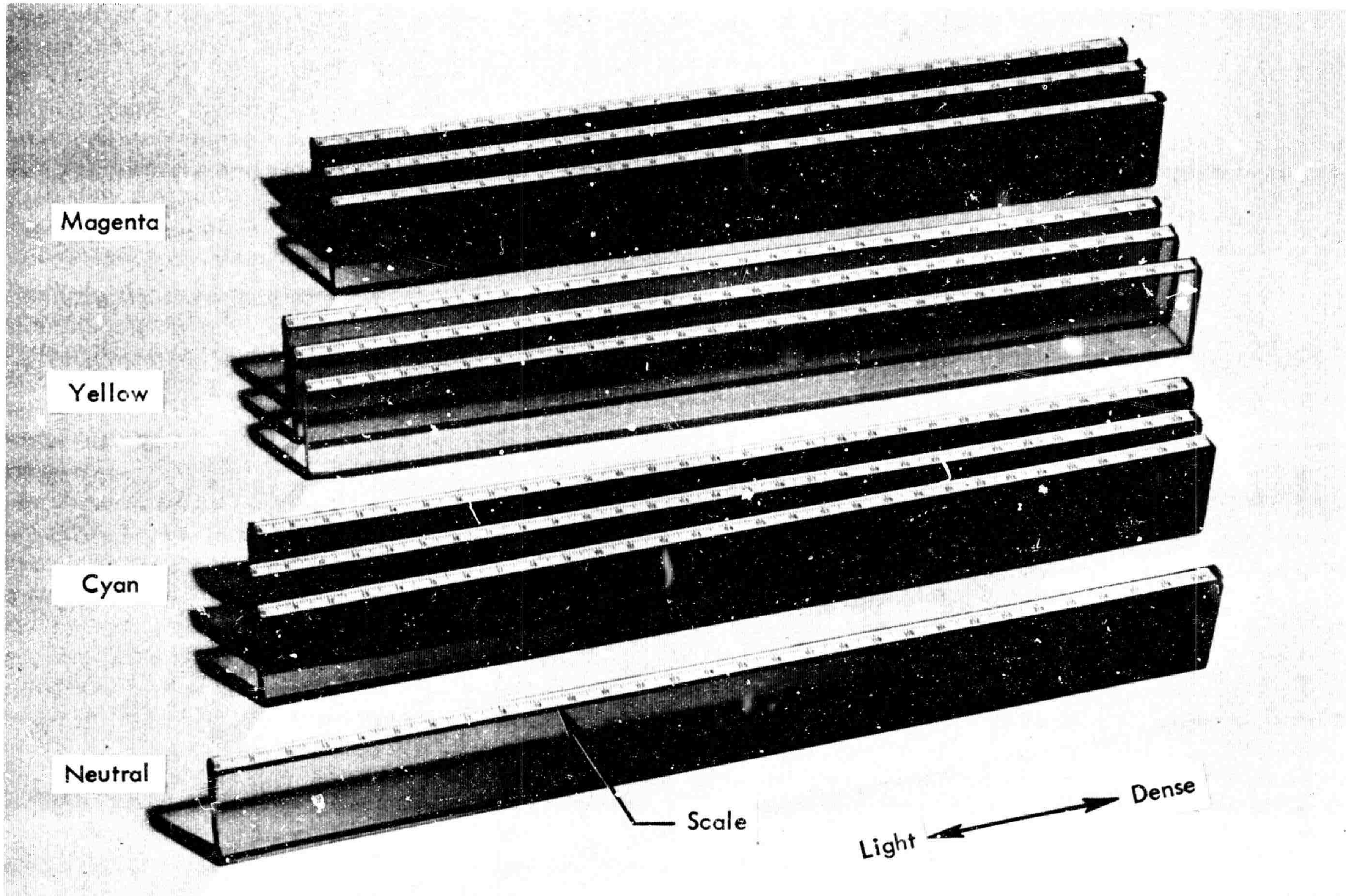


Fig. 15 -- Wedge Filters

and camera provides a focusing plane; the aperture plate covering the diffusing glass defines the shape and size of the image being photographed. The wedge filters were fabricated by Harrison and Harrison, Incorporated, Hollywood, California.

Each image is photographed, frame by frame, through the entire animation; if a particular animation has five images, the entire length of film is run through the camera five times. As the exposure of the film progresses for each image, the positions of the wedge filters and the locations of the stage assembly are changed to produce the desired color and position of the image. The camera has a bidirectional frame counter so that all images in the animation will have the same starting frame when the film is rewound. The flashtube is triggered with a cam-operated synchronization switch that was added to the camera; this switch closes when the shutter disc is open. The camera is driven by a shutter actuation motor at a maximum rate of four frames per minute. An additional electric counter is driven from the synchronization cam as a double check on frame number. Real time of the final display presentation is established by assuming a projection-system framing rate of 24 frames per second.

LIGHT SOURCE POWER SUPPLY

Electrical energy for the xenon flashtube is supplied by a regulated DC power supply and capacitor bank. Voltage is regulated to 900 ± 5 volts DC, since the light output of a flashtube can vary as much as the cube of the voltage, depending upon flashtube efficiency.[8] Oil-filled paper capacitors were chosen in preference to electrolytic capacitors because of their stability and long life. A switching arrangement enables capacitance to be increased in steps of 20 mfd to a maximum of 500 mfd. With the capacitor bank set at 240 mfd, input power to the flashtube is 97.2 watt-seconds and the power supply recycling time is about 7 seconds. The electrical schematic of the light source and power supply is included in the Appendix.

PROJECTION SYSTEM

After processing, the film is viewed with the projection system shown in Fig. 16 Rear projection was used so that images could be viewed directly without the use of mirrors or prisms, and actual display hardware could be simulated. The display format size selected was 12 in. by 15 in., a comfortable and realistic size for an observer seated approximately 40 in. from the display. A rear-projection material was chosen which would give maximum light transmission with minimum hot-spots; this material is spectrally nonselective throughout the wavelength range of .38 to .76 microns, and has a light transmission of approximately 50 percent. It is type S-50-R, manufactured by the Stewart Filmscreen Corporation of Torrance, California. The projector is a 16-mm 750-watt silent type, modified with a synchronous motor to run at 24 frames per second; other features include several framing rates below 24 fps, down to 1 fps, additional lamp cooling so that a single frame may be viewed without burning the film, and a bidirectional frame counter. The original projector was a Kodak Analyst Model BP-16AR, modified to a Model 224-AS Photo-Optical Data Analyser by L-W Photo, Incorporated, Van Nuys, California.

For film viewing by more than one observer, front projection on a flat white screen can be used, provided the viewing angle is small, say less than 15°. This would require a somewhat larger format, with corresponding loss in illuminance. However, a front-projection surface is generally more efficient, reflecting about 85 percent of the light, whereas the rear-projection surface transmits only 50 percent.

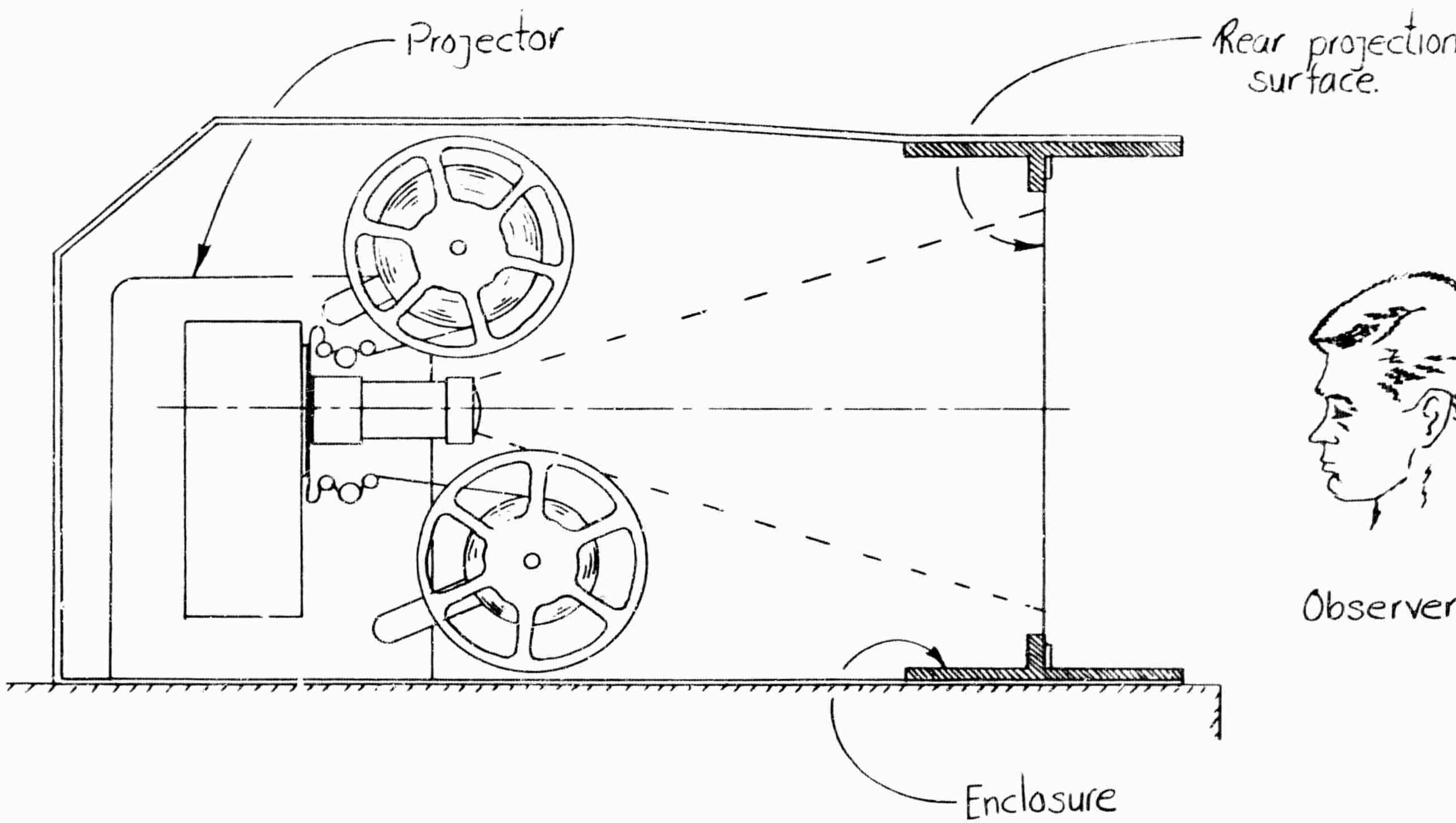


Fig. 16 -- Projection System.

V. FILM CALIBRATION

We have seen in Section III that a film calibration was necessary to relate spectral distribution and intensity of the exposing light to chromaticity of the final film image. Assuming that the flashtube voltage is not changed, this means that calibration must relate many different wedge filter and exposure combinations to film image chromaticity.

This type of film calibration is not new; a reverse calibration of subtractive color film has been used by Overington[9] to determine the surface temperature of a self-luminous body by color densitometry, where the use of thermocouples and similar instrumentation would have been impossible because of rapidly changing surface temperatures.

A schematic diagram of the formation of the film image and its resulting chromaticity when exposed in the animation stand is shown in Fig. 17. Indicated on the chromaticity diagram ar the locations of both the exposing light and the final film image. In this case we have used the yellow and cyan wedges to produce a green light, whose spectral distribution is indicated. Note that the chromaticity of the final film image is desaturated and nearer the achromatic point than that of the exposing light.[6]

Exposure of a specific type of color film to light of a certain spectral distribution and intensity does not completely define chromaticity of the final film image. There are many other conditions that affect image chromaticity, such as differences in film from one manufacturing lot to the next, storage of film at high temperature or humidity before and after exposure, and slight changes in processing from one batch to the next. To minimize the effect of these conditions, fresh film bearing the same emulsion number was obtained from a reputable manufacturer and processor. One roll was used for calibration and the remainder stored at low temperature and humidity. The film selected for use in the animation stand was Kodachrome II Daylight, manufactured and processed by Eastman Kodak Co., with an emulsion speed of ASA 25 to a 6100°K light source.

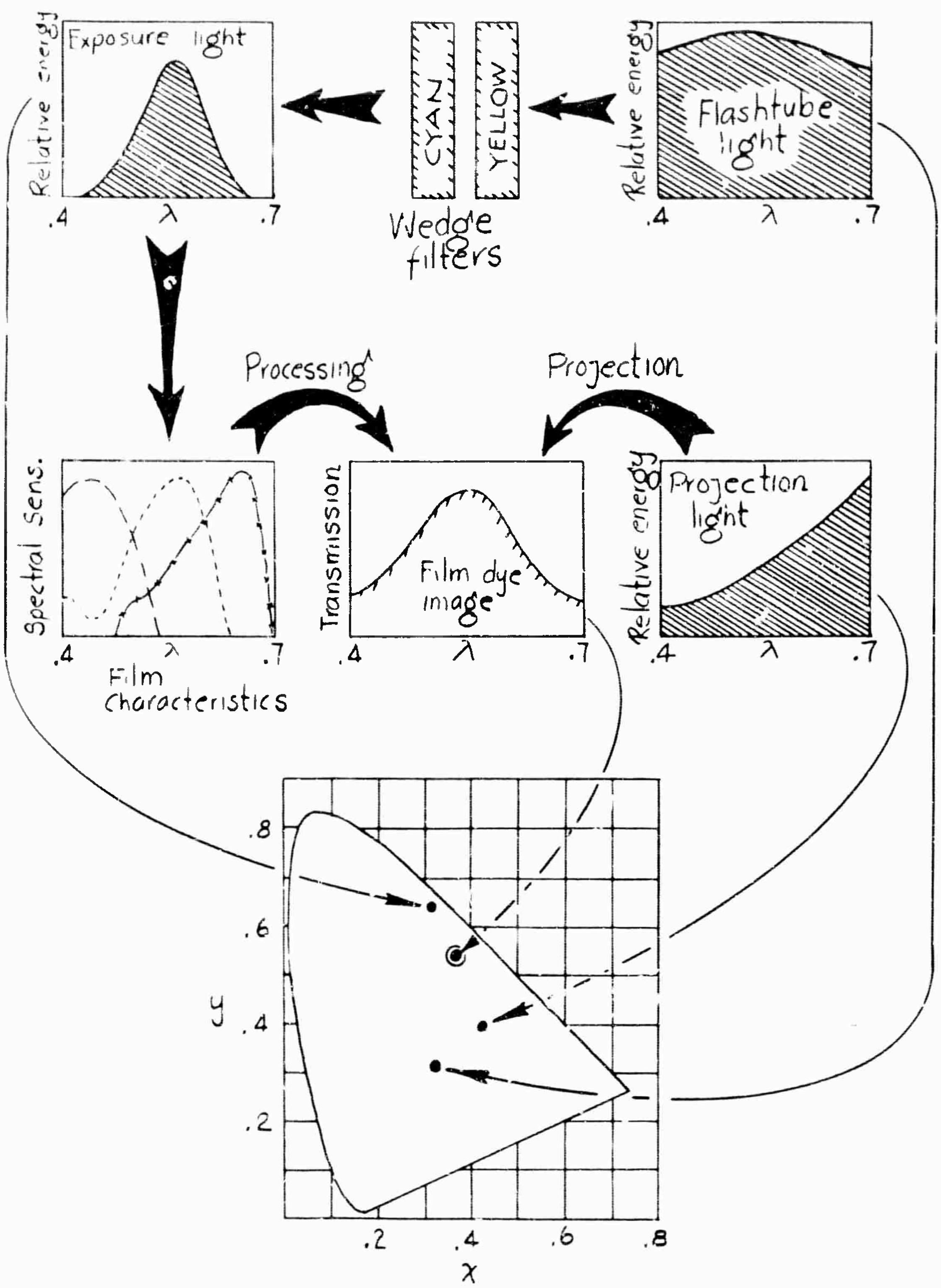


Fig. 17 -- Film image formation and resulting chromaticity for green-light exposure. Othe. chrcmaticities are also indicated.

To calibrate the film, a 1/2-in. diameter aperture plate was first placed over the opal diffusing glass on the wedge filter housing A 25-mm extension tube was then added to the camera so that the image of the aperture plate completely filled the 16-mm motion picture format. Consecutively decreasing exposures were then made on each of many different wedge filter combinations, and the film was processed. Each film image was then placed in a spectrophotometer and a spectral transmission curve was run from .38 to .76 microns. Spectral transmission data were then reduced to CIE chromaticity data x, y, and L, using 3200°K tungsten as the achromatic point. For each group of exposures from the different wedge filter settings, x and y chromaticity were individually plotted against luminosity L. From these curves it is possible to interpolate the required wedge filter settings in order to produce a film image of some specific desired chromaticity and luminosity. A more detailed discussion of the film calibration procedure follows.

WEDGE FILTER SCALES

As explained in Section IV, each of the three filter hues consists of three separate filters whose densities overlap. These overlap points were first estimated from the wedge filter spectral transmission curves to provide a starting point for film calibration, and were later determined more accurately by actual tests on color films. The overlap points are as follows:

27.5 M1	=	2.1 M2	27.5 M2	=	1.6 M3
27.5 Y1	=	4.0 Y2	27.5 Y2	=	3.5 Y3
27.5 C1	=	4.3 C2	27.5 C2	=	9.4 C3

Neutral Wedge: 50 percent reduction in transmission (equal to 1 camera f/stop) between 2.0 Nu and 22.0 Nu

If the three filter scales for each hue are now combined into one continuous scale per hue (designated M, Y, and C), they become:

Magenta	(M)	2.0 through 78.8
Yellow	(Y)	2.0 through 75.0
Cyan	(C)	2.0 through 68.8

Note that the scale length is different for the three hues because of differences in overlap.

Conversion from continous scale values (M, Y, C) to individual scales (M1, Y2, C3, etc.) then becomes:

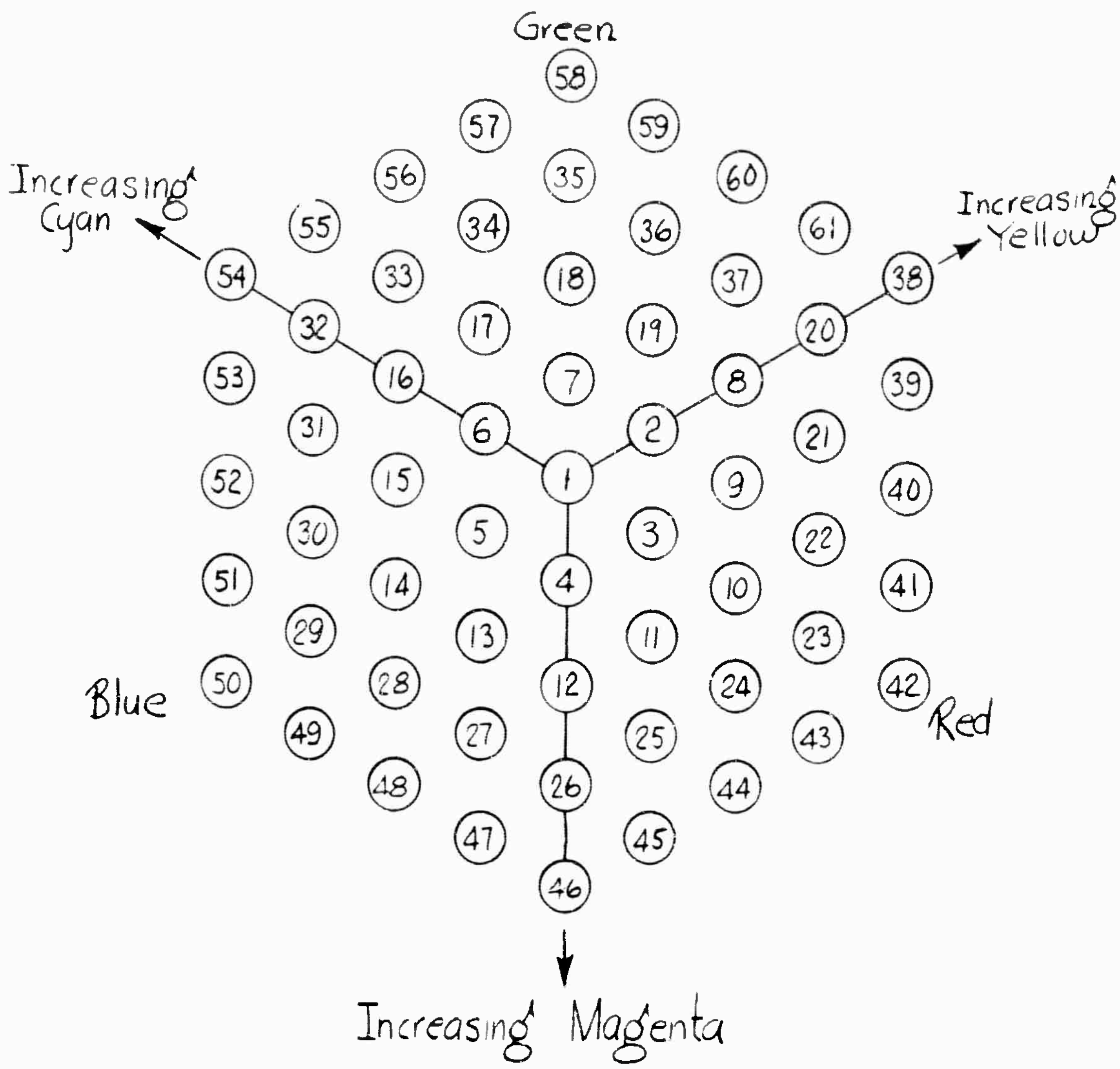
M1 = M, if M is between 2.0 and 27.5
M2 = M - 25.4, if M is between 27.5 and 52.9
M3 = M - 51.3, if M is between 52.9 and 78.8
M = M1
M = M2 + 25.4
M = M3 + 51.3

Y1 = Y, if Y is between 2.0 and 27.5
Y2 = Y - 23.5, if Y is between 27.5 and 51.0
Y3 = Y - 47.5, if Y is between 51.0 and 75.0
Y = Y1
Y = Y2 + 23.5
Y = Y3 + 47.5

C1 = C, if C is between 2.0 and 27.5
C2 = C - 23.2, if C is between 27.5 and 50.7
C3 = C - 41.3, if C is between 50.7 and 68.8
C = C1
C = C2 + 23.2
C = C3 + 41.3

WEDGE FILTER COMBINATIONS

For film calibration, five points were chosen on each of the three filter hues, ranging from 2.0 to maximum. (On any individual wedge filter, 2.0 and 27.5 are about the scale limits for adequate coverage of the 1/2-in. aperture plate.) The neutral filter was set at 2.0 for the entire calibration. One series of exposures was made of each possible combination of the five points of each hue. However, when two hues were greater than 2.0 on the continous scale, the third hue was set at 2.0; this was done because the color gamut of the film is not increased by use of all three colored wedges for any particular exposure. For instance, if we were using the yellow and cyan wedges together to produce a green film image, the addition of the magenta wedge would only desaturate the film image and make it darker. The resulting sixty-one possible wedge combinations are shown in Fig. 18; each combination was assigned an exposure series number, and continous scale points of each wedge are noted.



Magenta scale settings: 2.0, 21.2, 40.5, 59.6, 78.8

Yellow scale settings: 2.0, 20.1, 39.0, 59.6, 75.0

Cyan scale settings: 2.0, 18.7, 35.6, 52.1, 68.8

Neutral scale setting: 2.0 for all exposures

for example, 1 = 2.0 M + 2.0 Y + 2.0 C + 2.0 Nu
and 12 = 40.5 M + 2.0 Y + 2.0 C + 2.0 Nu
and 34 = 2.0 M + 39.0 Y + 52.1 C + 2.0 Nu

Fig. 18 -- Wedge filter combinations used for film calibration with corresponding exposure series numbers.

EXPOSURE

Each exposure series of different wedge filter settings consisted of nine exposures, ranging from f/2.8 to f/32. Two exposures were taken at full camera aperture, one with the power supply capacitance doubled. The use of the 25-mm extension tube on the camera meant a loss of two f/stops; however, a full-format image was necessary to accommodate the spectrophotometer. The viewing beam-splitter in the camera also contributes a light loss of approximately one-quarter f/stop. All exposures were given a calibration number. Complete calibration exposure data are given in the Film Calibration Table in the Appendix.

SPECTROPHOTOMETRY

After the film was processed, spectral transmission curves were run on the film images from .38 to .76 microns. Transmission curves of each exposure series were run on the same strip chart in order of descending exposures, until the entire transmission curve was under 5 percent. Most film images whose transmission curve lies beneath the 5 percent line have luminosities of less than 1 percent and are practically opaque to the human observer. This work was done on a Carey spectrophotometer by Spectrolab, Inc., Sylmar, California. Shown in Fig. 19 are typical strip-chart transmission curves for one exposure series.

REDUCTION OF SPECTROPHOTOMETRIC DATA TO CIE CHROMATICITY DATA

To facilitate the reduction of spectrophotometric data to chromaticity data by the usual integration method using tristimulus values of the spectrum,[2] a computer program was written. Symbols used in the text and their FORTRAN equivalents are given in Table 1.

The following equations were programmed:

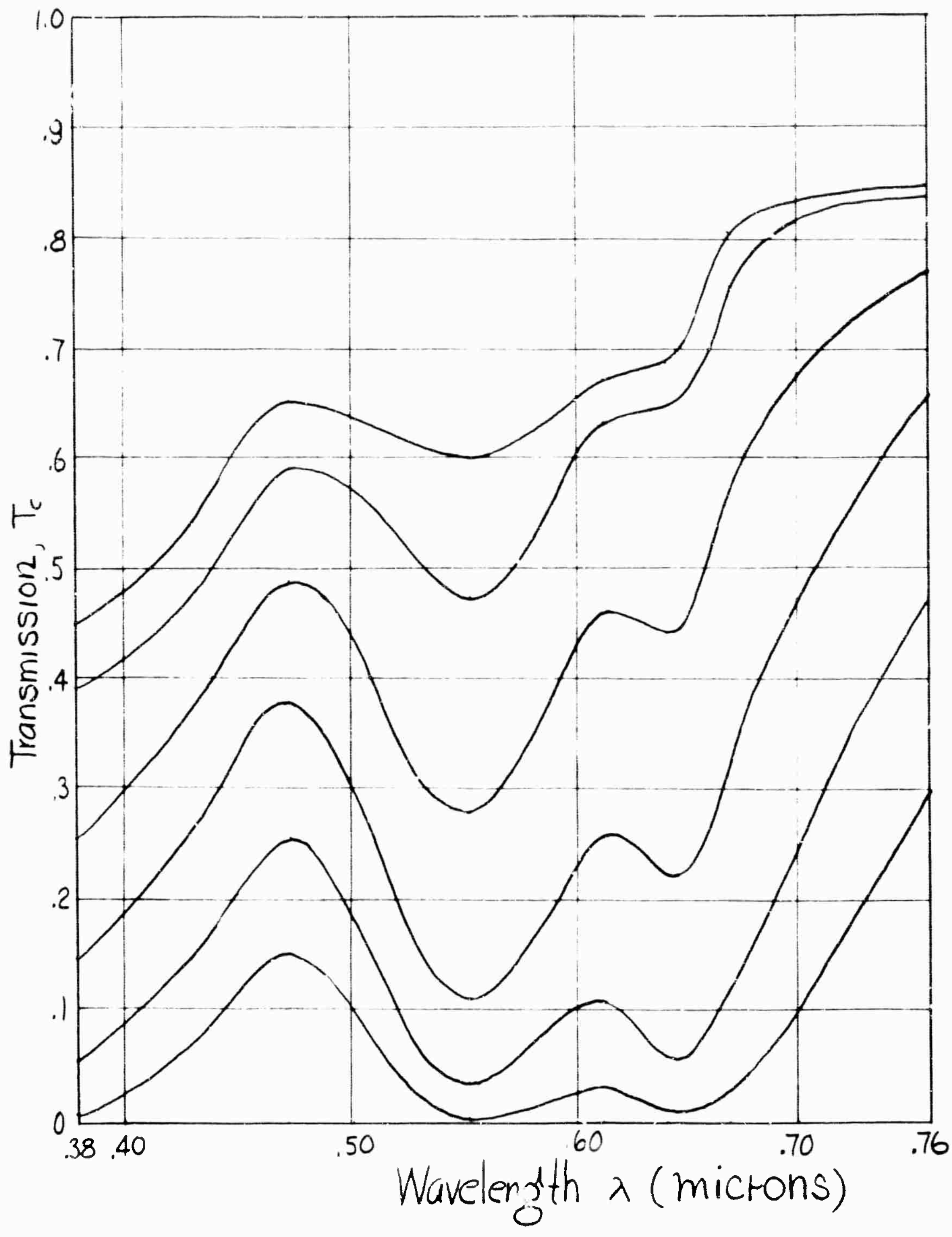


Fig. 19 -- Spectral transmission curves of six film calibration images of a nine-image exposure series (Series #14).

Table 1

FORTRAN NOMENCLATURE

FORTRAN	Text	Explanation
WL	λ	Wavelength, microns
S	E_s	Energy distribution of light source
X	t_x	Tristimulus values of the spectrum
Y	t_y	
Z	t_z	
OP	T_p	Spectral transmission of projector optics
SCR	T_s	" " " screen
TCI	T_c	" " " film image
UP	—	$E_sT_pT_sT_c$ (for each wavelength)
SXP	x_a	$E_sT_pT_st_x$ (summed over $\lambda = .38$ to $\lambda = .76$)
SYP	y_a	$E_sT_pT_st_y$ "
SZP	z_a	$E_sT_pT_st_z$ "
SXI	x_b	$E_sT_pT_sT_ct_x$ "
SYI	y_b	$E_sT_pT_sT_ct_y$ "
SZI	z_b	$E_sT_pT_sT_ct_z$ "
XBARP	$\bar{x}$	Chromaticity coordinates of achromatic point
YBARP	$\bar{y}$	
XBARI	x	Chromaticity coordinates of film calibration image
YBARI	y	
ELUM	L	Luminosity of film calibration image

$$x_a = \int_{.38}^{.76} (E_s T_p T_s t_x)\, d\lambda$$

$$y_a = \int_{.38}^{.76} (E_s T_p T_s t_y)\, d\lambda$$

$$z_a = \int_{.38}^{.76} (E_s T_p T_s t_z)\, d\lambda$$

where E_s is the spectral energy distribution of the light source, T_p is the spectral transmission of the projector optics, and T_s is the spectral transmission of the rear-projection screen. Both T_p and T_s were found to be so near to neutral that a value of 1.00 was used in the program. The tristimulus values of the spectrum are t_x, t_y, and t_z.

From the foregoing equations, the achromatic point on the chromaticity diagram was calculated:

$$\bar{x} = \frac{x_a}{\Sigma(x_a + y_a + z_a)} \qquad \bar{y} = \frac{y_a}{\Sigma(x_a + y_a + z_a)}$$

The x, y, and z [illegible]s were then expanded to include the film image transmission curves T_c:

$$x_b = \int_{.38}^{.76} (E_s T_p T_s T_c t_x)\, d\lambda$$

$$y_b = \int_{.38}^{.76} (E_s T_p T_s T_c t_y)\, d\lambda$$

$$z_b = \int_{.38}^{.76} (E_s T_p T_s T_c t_z)\, d\lambda$$

Combining the above equations,

$$x = \frac{x_b}{\Sigma(x_b + y_b + z_b)} \qquad y = \frac{y_b}{\Sigma(x_b + y_b + z_b)} \qquad L = \frac{y_b}{y_a}$$

where x and y are calibration chromaticity and L is luminosity.

The film image spectral transmission curves were read from .38 to .76 microns, at intervals of .02 microns; these data were fed into the accompanying FORTRAN IV program (Table 2) and run on the IBM 7044 computer. A sample of the output is shown in Table 3. The data deck arrangement is as follows:

Card 1 identification (60 columns available)
Card 2 NL
Card 3 through 6 light source data
Card 7 through 10 tristimulus values of x
Card 11 through 14 tristimulus values of y
Card 15 through 18 tristimulus values of z
Card 19 film image spectral transmission data
Card 20 identification for preceding card
Card 21 same as card 19 with new data
Card 22 same as card 20 with new identification

Any desired combinations of cards 19 and 20 may be used. The program prints a page of the input data and a page for each film image spectral transmission curve, containing the spectral distribution, the x-y coordinates of the achromatic point, the x-y coordinates of the chromaticity and the luminosity.

INTERPRETATION OF CHROMATICITY DATA

Chromaticity data of the calibration transmission curves from the computer program were entered in the Film Calibration Table in the Appendix. Not all the chromaticity data were entered, as film images from each exposure series were fed to the computer in order of descending exposure, and the computations were in many cases terminated when luminosities fell below .01.

In order to present chromaticity data in a useful form, x and y coordinates for each exposure series were plotted against luminosity L, making it possible to obtain x and y values of any exposure series at any value of luminosity, provided of course that luminosity went that high for the exposure series in question. A typical x-y-L plot for one exposure series is shown in Fig. 20. As many as 61 series of exposures on different wedge filter combinations (a total of 549 exposures) were used in order to permit linear interpolation of wedge filter values between calibration points on the chromaticity diagram

Table 2

PROGRAM AND INPUT DATA

FORTRAN Source List

```
ISN        SOURCE STATEMENT

  0 $IBFTC ROY
  1           OIMENS(ON RUN(10),S(50),X(50),Y(50),Z(50),TC1(50(,XP(50),YP(50),ZP
            A(50(,CO(50(,FC(50(,FIL(50(,WL(50(,TC(50),OP(50),SCR(50(,UP(50)
  2         1 FORMAT(12A6(
  3         2 FORMAT(1H1,11A6)
  4         3 FORMAT(1HO)
  5         4 FORMAT(6E12.6)
  6         5 FORMAT(1HO,5X,10HWAVELENGTH,9X,6HSOURCE,8X,16HPROJECTOR OPTICS,6X,
            A6HSCREEN,15X,1HX,17X,1HY,17X,1HZ)
  7         6 FORMAT(7E18.6(
 10         7 FORMAT (20F3.3)
 11         8 FORMAT(16)
 12        13 FORMAT(1H1,20X,25HIMAGE TRANSMISSION CURVES(
 13        14 FORMAT(4X,3E15.4)
 14        16 FORMAT (1HO,1X,37HACHROMATIC POINT OF PROJECTION SYSTEM,14X,14HIMA
            AGE LOCAT(ON,28X,10HLUMINOSITY)
 15        17 FORMAT(1HO,2X,6HXBARP=E11.4,2X,6HYBARP=E11.4,3X,6HXBAR1=E11.4,2X,6
            AHYBAR1=E11.4,3X,6HSUMYP=E11.4,1X,6HSUMY1=E11.4,1X,2HL=E11.4(
 16        20 FORMAT(9X,10HWAVELENGTH,4X,5HIMAGE,10X,11HSPEC. DIST.)
 17        21 FORMAT(1HO,11A6)
 20           READ 1,(RUN(K),K=1,10)
 25           PRINT2,(RUN(K(,K=1,10)
 32           REAO 8,NL
 34           REAO 4,(S(N),N=1,NL)
 41           REAO 4,(X(N),N=1,NL)
 46           REAO 4,(Y(N),N=1,NL)
 53           REAO 4,(Z(N),N=1,NL)
 60           00 700 N=1,NL
 61           OP(N)=1.0
 62           SCR(N)=1.0
 63       700 CONTINUE
 65           WL(1(=380.
 66           DO 50 N=2,NL
 67           WL(N)=WL(N-1)+20.
 70        50 CONTINUE
 72           PRINT 5
 73           PRINT 3
 74           PRINT 6,(WL(N),S(N),OP(N),SCR(N),X(N(,Y(N),Z(N),N=1,NL)
101       100 READ 7,(TC1(N),N=1,NL)
106           PRINT 13
107           READ  1,(FIL(1),I=1,10(
114           PRINT 21,(FIL(1),I=1,10)
121           00 51 N=1,NL
122        51 UP(N)=S(N)*OP(N)*SCR(N)*TC1(N)
124           PRINT 3
125           PRINT 20
126           PRINT 3
127           PRINT 14,(WL(N),TC1(N),UP(N),N=1,NL(
134           SXP=0.
135           SYP=0.
136           SZP=0.
137           SX1=0.

140           SY1=0.
141           SZ1=0.
142           00 15 N=1,NL
143           XP(N)=S(N)*X(N)
144           SXP=SXP+XP(N)
145           YP(N)=S(N)*Y(N)
146           SYP=SYP+YP(N)
147           ZP(N)=S(N)*Z(N)
150           SZP=SZP+ZP(N)
151           SX1=SX1+TC1(N)*XP(N)
152           SY1=SY1+TC1(N)*YP(N)
153           SZ1=SZ1+TC1(N)*ZP(N)
154        15 CONTINUE
156           OP=SXP+SYP+SZP
157           XBARP=SXP/OP
160           YBARP=SYP/OP
161           OI=SX1+SY1+SZ1
162           XBAR1=SX1/OI
163           YBAR1=SY1/OI
164           ELUM=SY1/SYP
165           PRINT 16
166           PRINT 17,XBARP,YBARP,XBAR1,YBAR1,SY1,SYP,ELUM
167           GO TO 100
170           CALL EXIT
171           ENO
```

Table 2 (cont.)
Light Source and Tristimulus Value Input

WAVELENGTH	SOURCE	PROJECTOR OPTICS	SCREEN	X	Y	Z
0.380000E 03	0.230000E 00	0.100000E 01	0.100000E 01	0.140000E-02	0.	0.650000E-02
0.400000E 03	0.330000E 00	0.100000E 01	0.100000E 01	0.143000E-01	0.400000E-03	0.679000E-01
0.420000E 03	0.435000E 00	0.100000E 01	0.100000E 01	0.134400E 00	0.400000E-02	0.645600E 00
0.440000E 03	0.540000E 00	0.100000E 01	0.100000E 01	0.348300E 00	0.230000E-01	0.174710E 01
0.460000E 03	0.675000E 00	0.100000E 01	0.100000E 01	0.290800E 00	0.600000E-01	0.166920E 01
0.480000E 03	0.820000E 00	0.100000E 01	0.100000E 01	0.956000E-01	0.139000E 00	0.813000E 00
0.500000E 03	0.960000E 00	0.100000E 01	0.100000E 01	0.490000E-02	0.323000E 00	0.272000E 00
0.520000E 03	0.110000E 01	0.100000E 01	0.100000E 01	0.633000E-01	0.710000E 00	0.782000E-01
0.540000E 03	0.124000E 01	0.100000E 01	0.100000E 01	0.290400E 00	0.954000E 00	0.203000E-01
0.560000E 03	0.138000E 01	0.100000E 01	0.100000E 01	0.594500E 00	0.995000E 00	0.390000E-02
0.580000E 03	0.153000E 01	0.100000E 01	0.100000E 01	0.916300E 00	0.870000E 00	0.170000E-02
0.600000E 03	0.164000E 01	0.100000E 01	0.100000E 01	0.106220E 01	0.631000E 00	0.800000E-03
0.620000E 03	0.175000E 01	0.100000E 01	0.100000E 01	0.854400E 00	0.381000E 00	0.200000E-03
0.640000E 03	0.184000E 01	0.100000E 01	0.100000E 01	0.447900E 00	0.175000E 00	0.
0.660000E 03	0.195000E 01	0.100000E 01	0.100000E 01	0.164900E 00	0.610000E-01	0.
0.680000E 03	0.204000E 01	0.100000E 01	0.100000E 01	0.468000E-01	0.170000E-01	0.
0.700000E 03	0.211000E 01	0.100000E 01	0.100000E 01	0.114000E-01	0.410000E-02	0.
0.720000E 03	0.216000E 01	0.100000E 01	0.100000E 01	0.290000E-02	0.100000E-02	0.
0.740000E 03	0.224000E 01	0.100000E 01	0.100000E 01	0.700000E-03	0.300000E-03	0.
0.760000E 03	0.228000E 01	0.100000E 01	0.100000E 01	0.200000E-03	0.100000E-03	0.

Table 3

IMAGE TRANSMISSION CURVES AND OUTPUT DATA (SAMPLE)

CALIBRATION 5

WAVELENGTH	IMAGE	SPEC. DIST.
0.3800E 03	0.4640E 00	0.1067E 00
0.4000E 03	0.4720E 00	0.1558E 00
0.4200E 03	0.5090E 00	0.2214E 00
0.4400E 03	0.5730E 00	0.3094E 00
0.4600E 03	0.6190E 00	0.4178E 00
0.4800E 03	0.6420E 00	0.5264E 00
0.5000E 03	0.6400E 00	0.6144E 00
0.5200E 03	0.6300E 00	0.6930E 00
0.5400E 03	0.6150E 00	0.7626E 00
0.5600E 03	0.6230E 00	0.8597E 00
0.5800E 03	0.6570E 00	0.1005E 01
0.6000E 03	0.6800E 00	0.1115E 01
0.6200E 03	0.6790E 00	0.1188E 01
0.6400E 03	0.6890E 00	0.1268E 01
0.6600E 03	0.7830E 00	0.1527E 01
0.6800E 03	0.8100E 00	0.1652E 01
0.7000E 03	0.8180E 00	0.1726E 01
0.7200E 03	0.8280E 00	0.1805E 01
0.7400E 03	0.8380E 00	0.1877E 01
0.7600E 03	0.8480E 00	0.1933E 01

ACHROMATIC POINT OF PROJECTION SYSTEM

XBARP= 0.4169E 00   YBARP= 0.3975E 00

IMAGE LOCATION

XBARI= 0.4293E 00   YBARI= 0.3982E 00

LUMINOSITY

SUMYP= 0.4763E 01 SUMYI= 0.7336E 01 L= 0.6493E 00

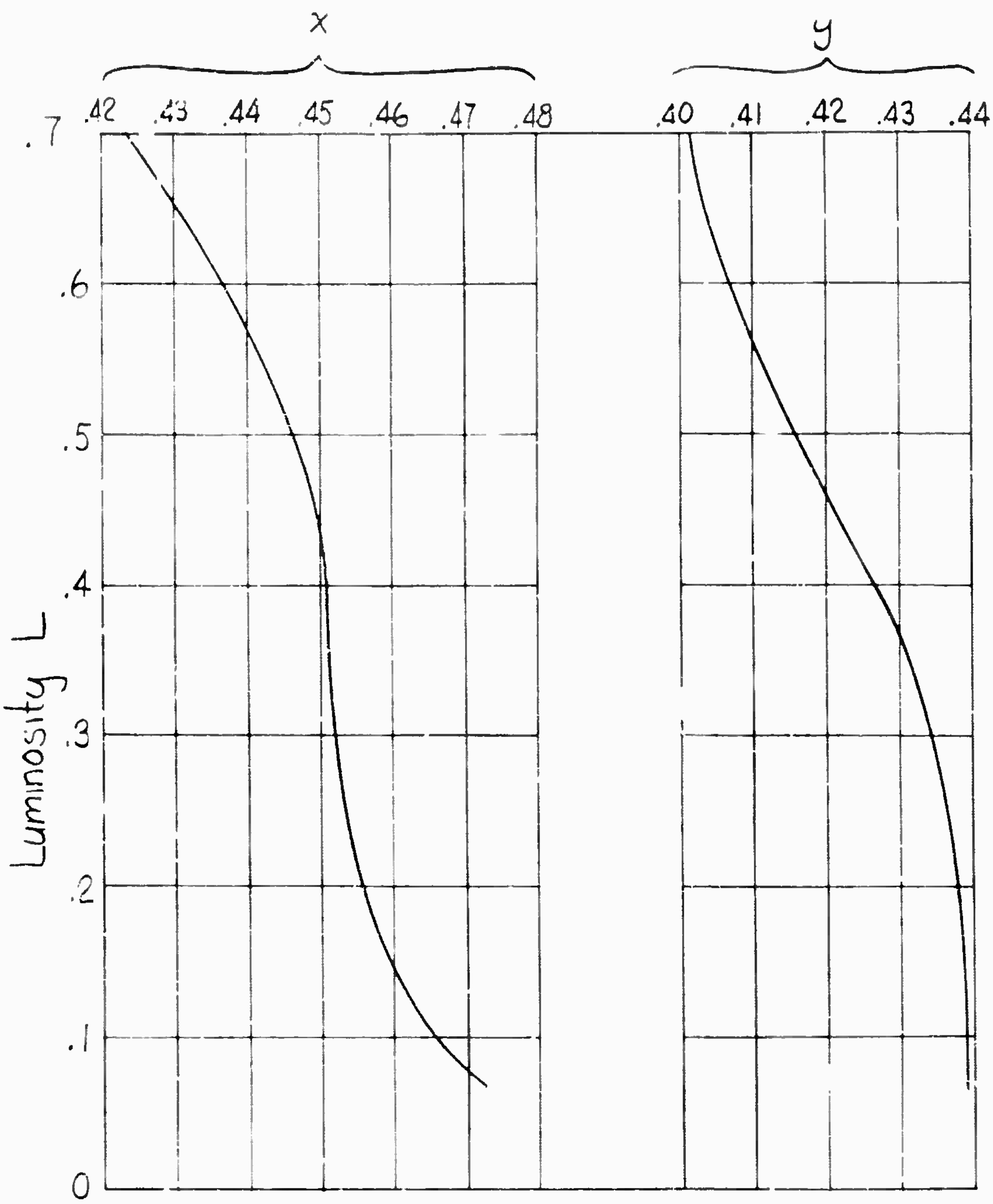


Fig. 20 -- Typical plot of x and y chromaticity values against luminosity for one exposure series (Series #2).

at any level of luminosity with fair accuracy.

The chromaticity diagram of Fig. 21 shows the approximate maximum color gamut of the film in the simulator; 'contour' lines of constant luminosity are indicated, showing that color gamut decreases as luminosity increases. The maximum luminosity obtainable with Kodachrome II film is about .70; that is, of course, the result of combined transmission of the maximum reduction of the three dye image densities plus the density of the film support.

Had the film calibration been made using a higher light-output flashtube, or perhaps multiple flashes per image, the resulting chromaticity gamut of the film could have been increased somewhat, particularly when calibrating the dense ends of the subtractive wedge filters; this is because the combined transmission of two wedges at or near their dense ends is comparatively sharp-cutting and therefore results in saturated film colors, but the luminosity of the film image is of course limited by the intensity of the exposing light.

ADDITIONAL TESTS

To check repeatability, several neutral grey images of approximately .10 luminosity were exposed consecutively on the calibration film; the highest luminosity was .1007, and the lowest .0946, giving a total variation of 6.24 percent. The high and low chromaticities of these images were x = .3961 down to .3955, y = .3853 down to .3832. This indicates excellent repeatability in chromaticity and moderately good repeatability in luminosity.

As a check on possible variations in spectral distribution and light output between one flashtube and the next, consecutive neutral grey images were exposed on the film with six different off-the-shelf flashtubes of the same make and type; the highest luminosity was .2664, and the lowest was .2364, giving a total variation of 12.61 percent. High and low chromaticities of these images were x = .4100 down to .4077, and y = .3931 down to .3898. Again, repeatability in chromaticity is excellent, indicating that spectral energy distribution changes little from one flashtube to another; however, the variation in light

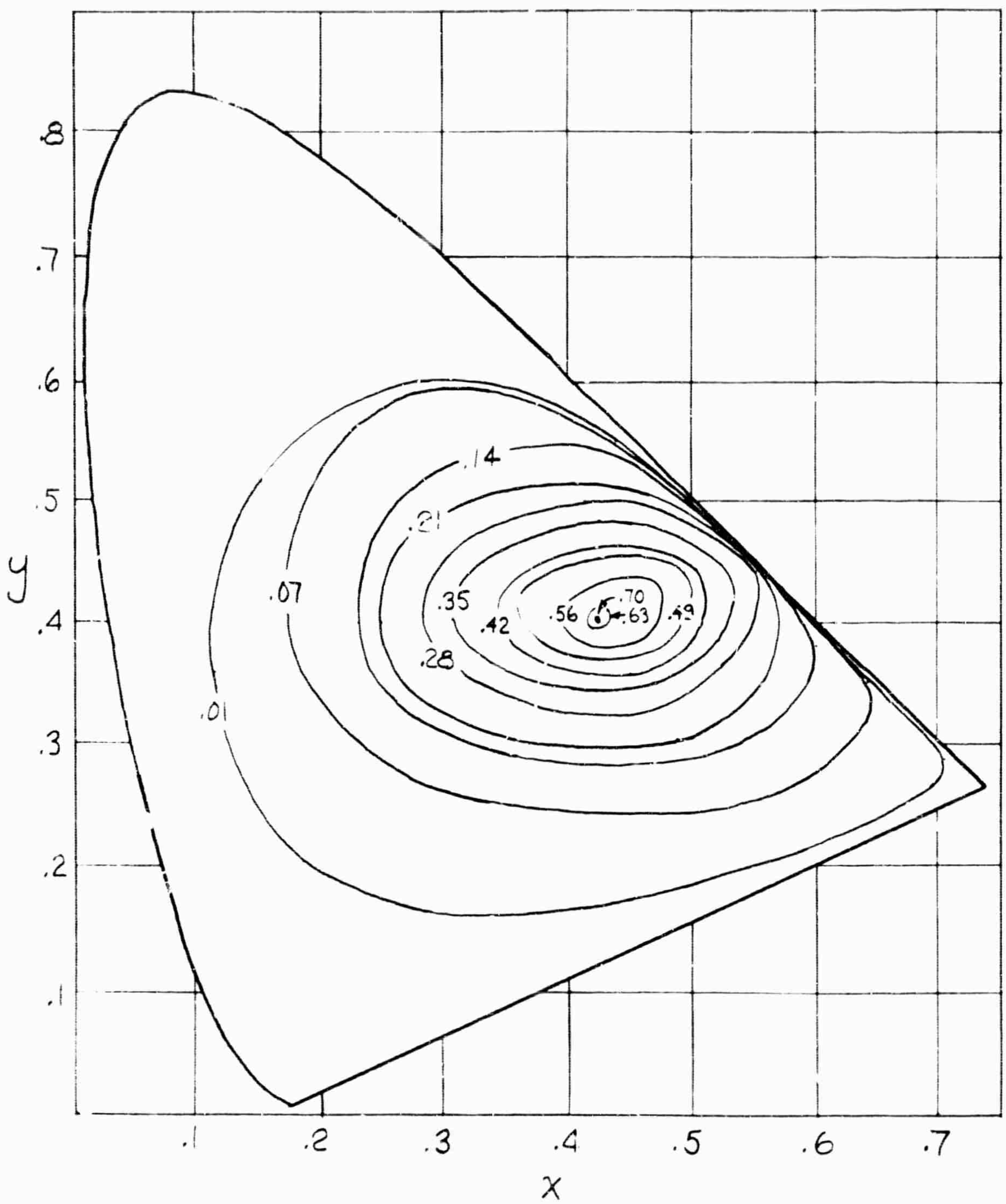


Fig. 21 -- Approximate maximum chromaticity gamut of film in the simulator for eleven levels of luminosity as indicated.

output was somewhat greater. The total combined effect of film repeatability and flashtube differences is quite unlikely to occur on one animation run, assuming the flashtube is not changed.

Variations in flashtube voltage were tested by disconnecting the voltage regulator stage on the power supply and exposing two neutral grey images on the film consecutively, one at 950 volts and the other at 850 volts; the highest luminosity was .2615 and the lowest was .2061, giving a total variation of 23.70 percent for the 100-volt difference. There was no chromaticity difference. This voltage variation is ten times that allowed by the regulated circuit, so luminosity could be expected to vary about 2.5 percent at most.

From the foregoing tests it is evident that luminosity of the film image, but not color, is affected by small changes in exposure parameters. If variations in processing were added to the above figures, the total spread in film image luminosity could be as high as about 20 percent. However, it is highly improbable that all conditions that determine image luminosity will act in the same direction.

VI. DISCUSSION

The present design of the display simulator satisfies the requirement of the project for which it was built, which is mainly to produce colored images with quite small differences in chromaticity grouped around the achromatic or 'white' point. These images are for the purpose of conducting color discrimination tests on human observers, and do not demand high luminosity differences between two images whose chromaticities are nearly the same and whose colors are fairly saturated. The chromaticity gamut at high luminosity levels is quite restricted. With the possible exception of this limitation, it is the writer's opinion that the design of the display simulator is adaptable to other projects.

Occasions could arise requiring a larger chromaticity gamut than the present simulator affords. As we have seen, the chromaticity gamut is determined by film characteristics and spectral characteristics of the exposure light. Not much can be done with the spectral dye densities and spectral sensitivities of off-the-shelf color film; the light source, however, can be controlled. For maximum color saturation or 'purity' of the film image on the boundary of the chromaticity gamut, exposures could be made with monochromatic light, thus permitting more selective dye-image reduction. Let us suppose that instead of the subtractive wedge filters with their comparatively broad-band transmission curves and one light source, we have two variable-wavelength monochromatic light sources. By combining different amounts of the two sources, we should be able completely to encompass the chromaticity gamut of the film itself, because we could then reduce the dye density of one, two, or three dyes, depending on the wavelength and intensity of each monochrometer. This could also be done with multiple exposures through narrow-band filters. In either case we are letting the overlapping spectral sensitivities of the three dye layers in the film work to our advantage. The obvious disadvantage is that exposure times might be excessive unless the monochrometers or narrow-band filters had very intense light sources, either tungsten or gas discharge tube. Also, the light-mixing optics for the two sources would be more complex than

our present design. If the two light sources were not truly monochromatic, but had a band width of, say, .02 microns, dyes could still be separated fairly well with much less exposure.

Another improvement might be to have the subtractive wedge filters or monochrometers servo controlled to adjust their position with time while the camera runs at a constant framing rate, thereby eliminating the tedious frame-by-frame manual filter setting. This would require additional electronic and mechanical hardware, but might be worthwhile if many films were to be made. If X-Y positioning of the stage assembly were also servo controlled, the operation of the animation stand could be almost completely programmed.

APPENDIX

POWER SUPPLY SCHEMATIC

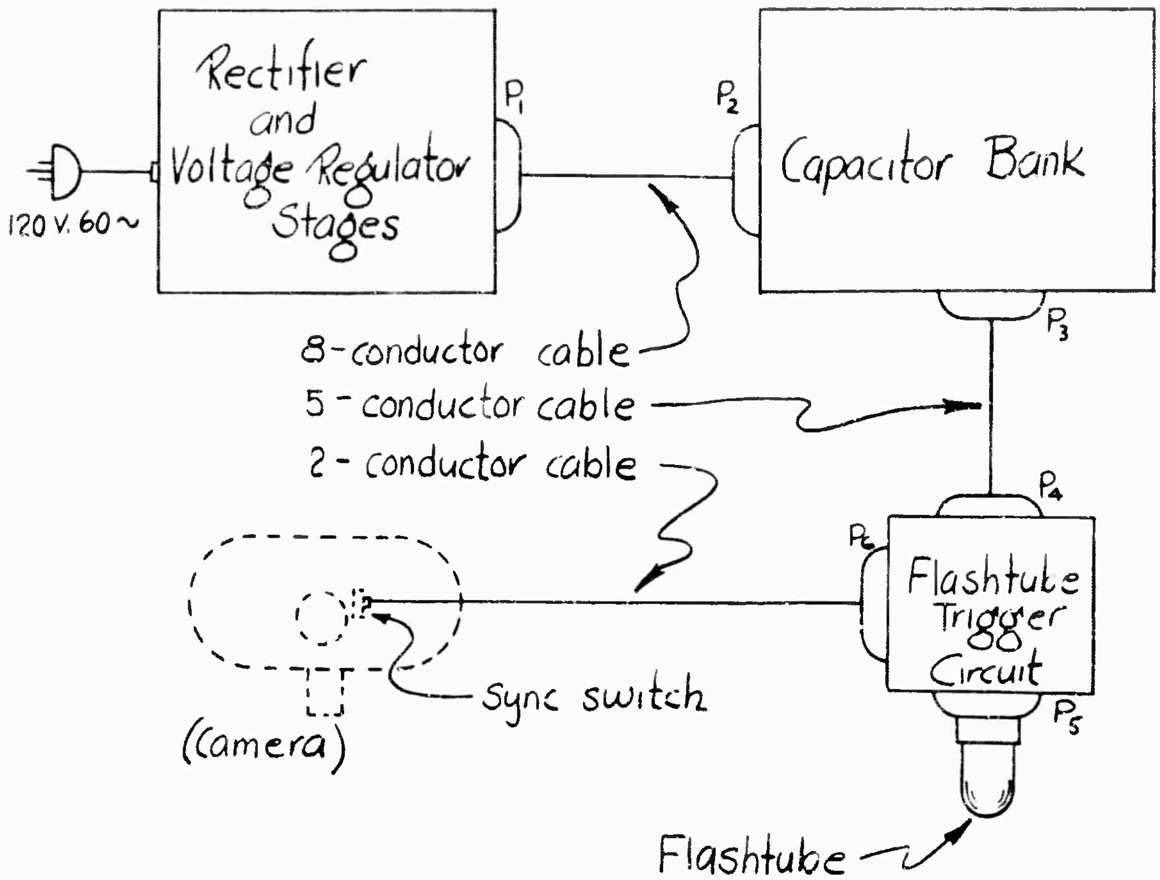
Figure 22 is a breakdown of the four main stages of the power supply system, and Figs. 23 through 26 are electrical schematic diagrams of each stage. The rectifier and voltage regulation stages are housed in a single unit, and the capacitor bank and flashtube trigger circuit are housed separately.

SPECTRAL TRANSMISSION CURVES OF WEDGE FILTERS

Spectral transmission curves were run at four points on each of the ten wedge filters. These points have scale readings of 2.0, 10.5, 19.0, and 27.5. These data are tabulated in Tables 4a through 4j, with one table for each wedge. The wavelength λ runs from 380 to 760 millimicrons, taken at intervals of 10 millimicrons.

FILM CALIBRATION EXPOSURE DATA

These data are tabulated in Table 5 for the 61 series of exposures, with 9 exposures to each series, for a total of 549 calibration frames. Wedge filter combinations, camera aperture (both indicated and actual), and capacitance (microfarads) are indicated, as well as the resulting chromaticity and luminosity data. Calibration frames with no chromaticity or luminosity data entered either had transmission curves so close to the adjacent one that they could not be accurately read, or their luminosity was less than .01. Voltage was held at 900 VDC throughout the calibration. The film used was Kodachrome II, emulsion number 7265379-C.



General Notes:

1) Wiring in cables P_1-P_2 and P_3-P_4 is pin-to-pin.
2) Component manufacturer specified in only those cases where a preference exists.
3) Resistors are $\frac{1}{2}$ watt unless otherwise noted.

Fig. 22 -- Power supply schematic breakdown.

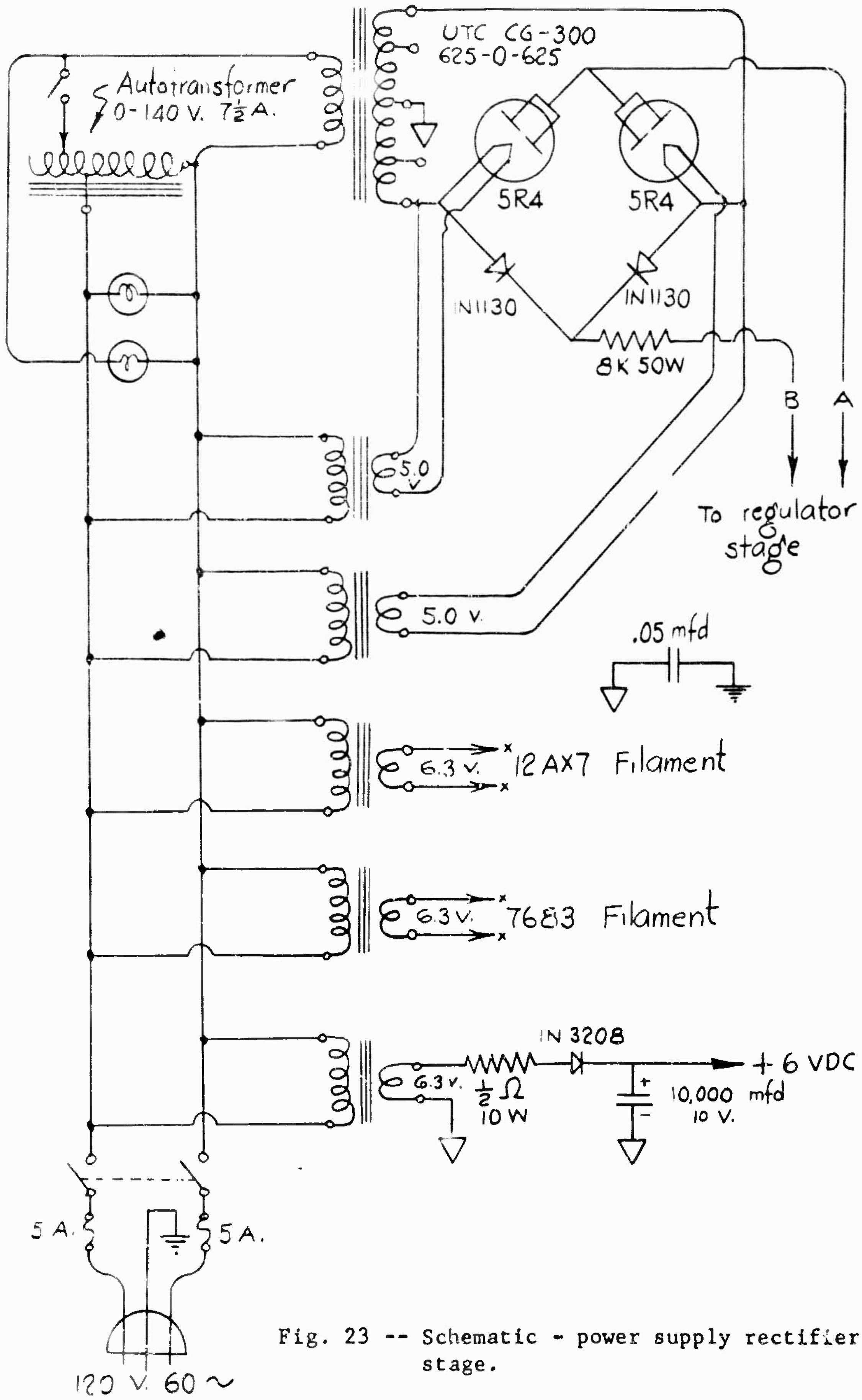


Fig. 23 -- Schematic - power supply rectifier stage.

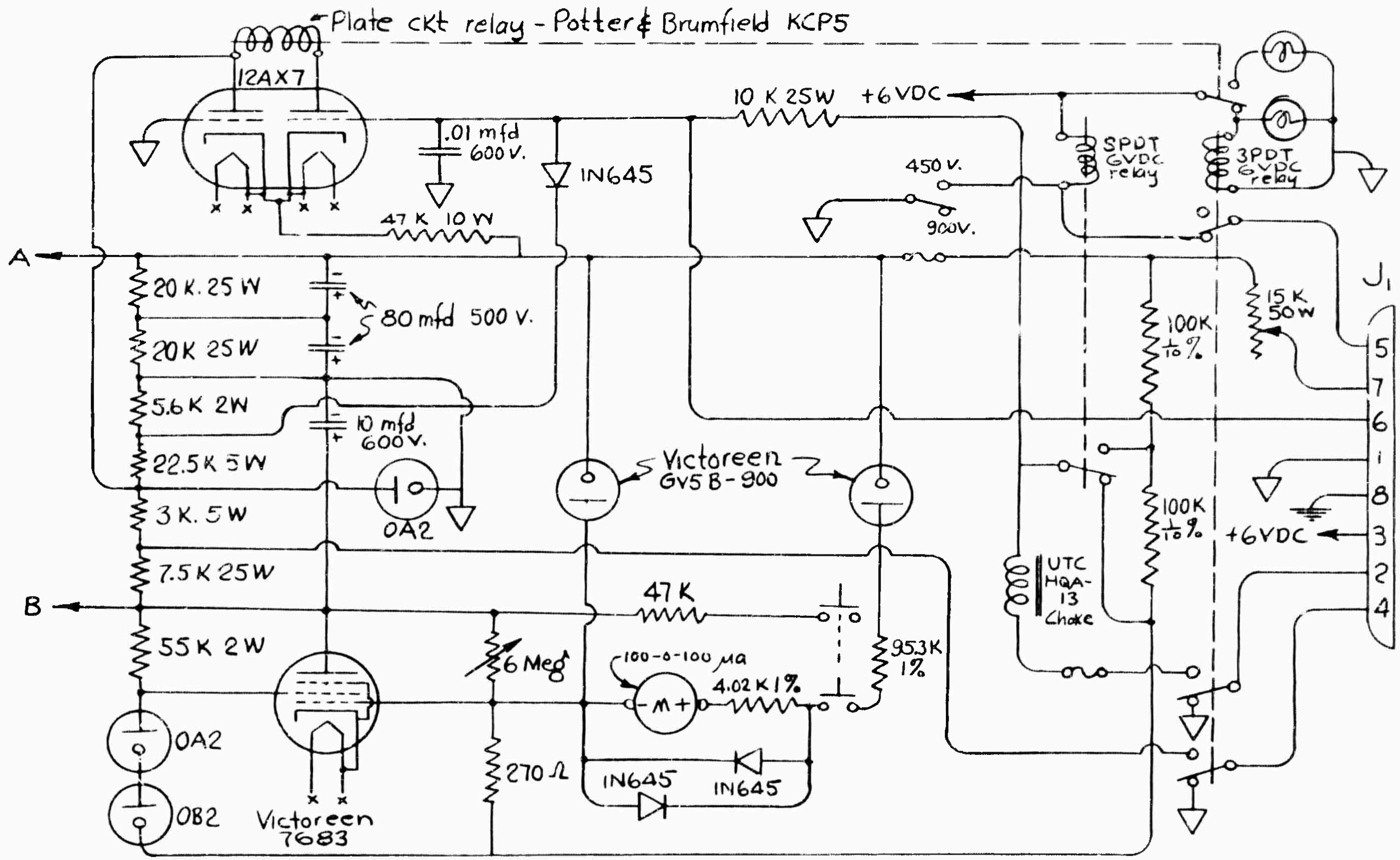


Fig. 24 -- Schematic - power supply regulator stage.

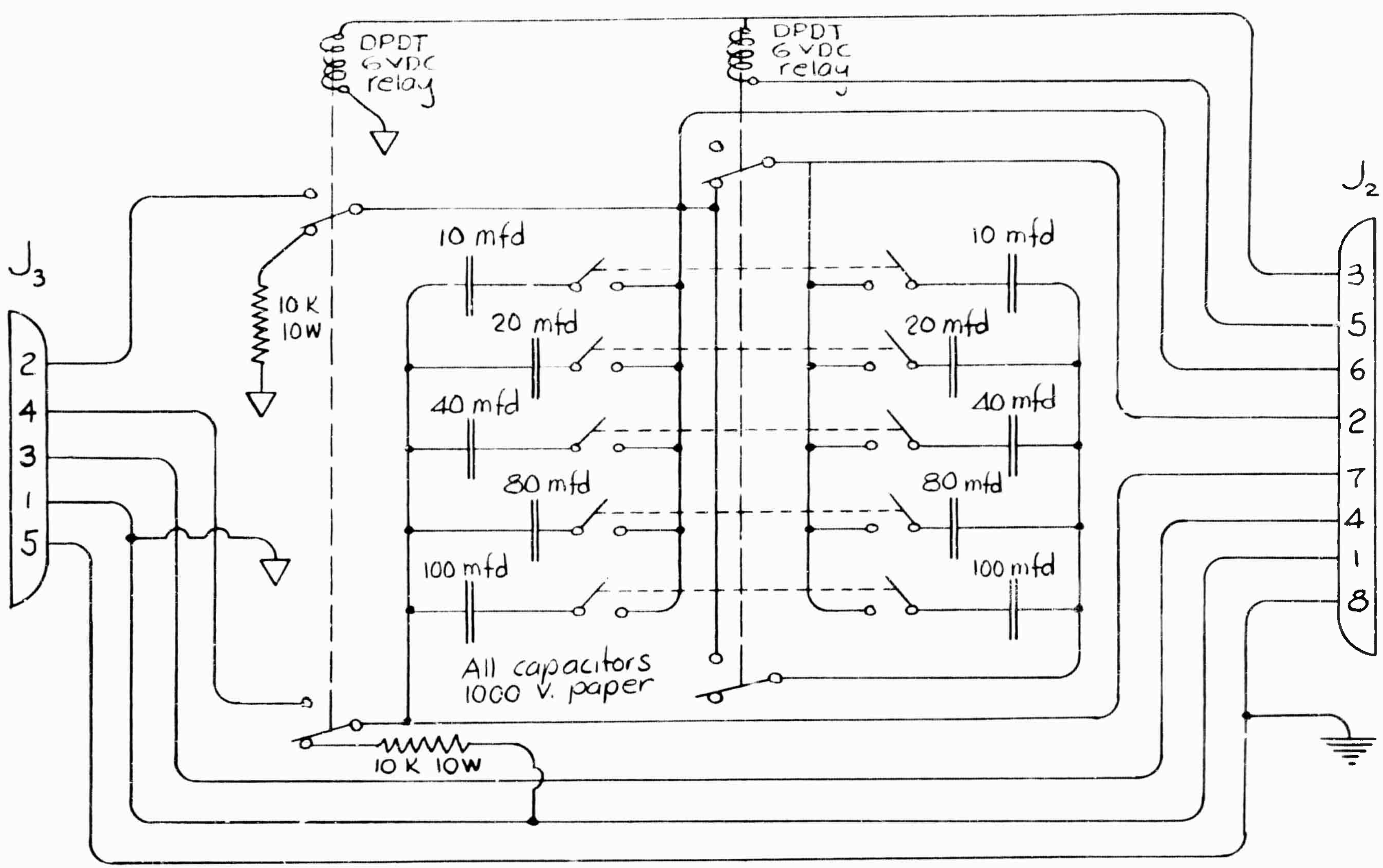


Fig. 25 -- Schematic - power supply capacitor bank.

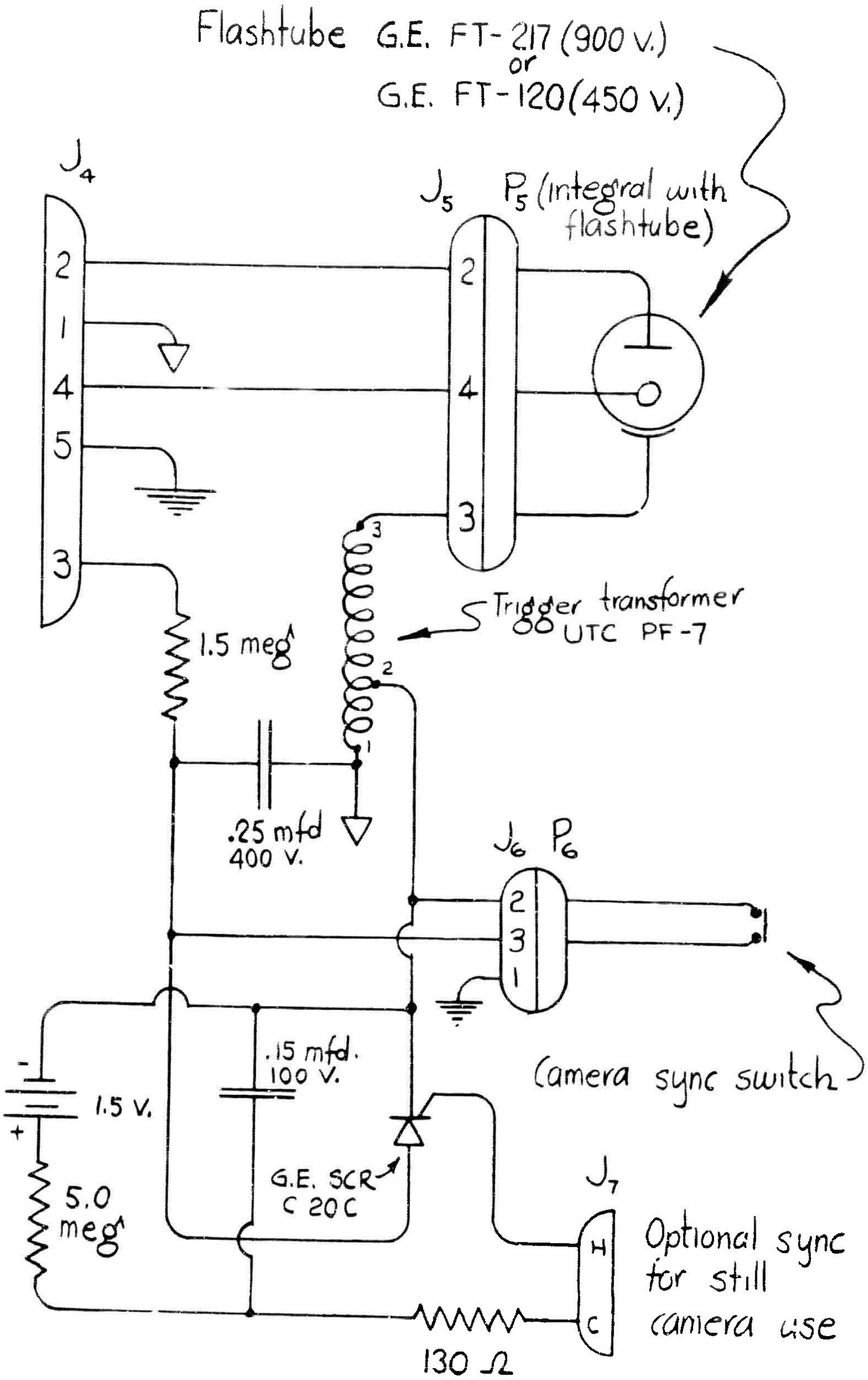


Fig. 26 -- Schematic - flashtube trigger.

Table 4a

SPECTRAL TRANSMISSION DATA MAGENTA 1 WEDGE

λ	2.0M1	10.5M1	19.0M1	27.5M1
380	.812	.657	.539	.445
390	.850	.753	.668	.590
400	.871	.792	.727	.660
410	.878	.808	.754	.690
420	.879	.811	.760	.696
430	.878	.804	.748	.685
440	.872	.786	.723	.645
450	.866	.759	.685	.591
460	.854	.723	.625	.515
470	.841	.675	.555	.435
480	.825	.620	.480	.353
490	.803	.558	.408	.278
500	.782	.498	.340	.210
510	.762	.450	.287	.164
520	.747	.415	.248	.134
530	.736	.389	.220	.114
540	.730	.378	.210	.107
550	.731	.388	.218	.114
560	.743	.417	.245	.138
570	.763	.468	.300	.182
580	.795	.542	.380	.260
590	.821	.614	.469	.349
600	.836	.660	.529	.415
610	.845	.690	.569	.461
620	.855	.725	.621	.524
630	.870	.776	.686	.614
640	.883	.824	.761	.710
650	.893	.856	.819	.780
660	.897	.875	.853	.829
670	.900	.887	.872	.854
680	.901	.891	.879	.866
690	.902	.893	.884	.872
700	.900	.893	.886	.874
710	.899	.893	.888	.876
720	.899	.895	.888	.878
730	.898	.894	.889	.878
740	.898	.894	.889	.879
750	.898	.894	.889	.880
760	.898	.895	.890	.880

Table 4b

SPECTRAL TRANSMISSION DATA MAGENTA 2 WEDGE

λ	2.0M2	10.5M2	19.0M2	27.5M2
380	.498	.412	.318	.255
390	.653	.586	.510	.451
400	.719	.660	.598	.550
410	.745	.688	.633	.587
420	.745	.687	.629	.583
430	.722	.655	.598	.547
440	.685	.601	.538	.480
450	.628	.530	.459	.395
460	.550	.444	.367	.298
470	.470	.353	.275	.208
480	.389	.270	.193	.135
490	.310	.195	.128	.081
500	.238	.136	.081	.045
510	.188	.100	.053	.027
520	.152	.075	.037	.017
530	.130	.059	.027	.011
540	.119	.053	.023	.009
550	.123	.057	.026	.010
560	.143	.071	.034	.014
570	.183	.100	.054	.026
580	.255	.161	.096	.055
590	.343	.239	.163	.107
600	.416	.313	.229	.164
610	.465	.363	.279	.210
620	.528	.430	.348	.275
630	.610	.534	.454	.383
640	.700	.640	.579	.519
650	.774	.734	.690	.649
660	.826	.799	.770	.742
670	.857	.836	.821	.800
680	.869	.854	.845	.829
690	.876	.863	.857	.846
700	.878	.867	.862	.852
710	.879	.869	.865	.856
720	.881	.870	.868	.860
730	.882	.872	.870	.863
740	.883	.873	.872	.866
750	.883	.874	.874	.868
760	.884	.875	.876	.869

Table 4c

SPECTRAL TRANSMISSION DATA MAGENTA 3 WEDGE

λ	2.0M3	10.5M3	19.0M3	27.5M3
380	.255	.104	.033	.007
390	.450	.271	.142	.064
400	.544	.375	.229	.129
410	.584	.418	.272	.163
420	.578	.408	.258	.153
430	.543	.364	.216	.118
440	.474	.289	.147	.069
450	.388	.201	.082	.030
460	.293	.120	.035	.008
470	.201	.062	.011	....
480	.128	.028	.002	....
490	.075	.009	....	....
500	.042	.001	....	....
510	.024	....	....	....
520	.015	....	....	....
530	.009	....	....	....
540	.008	....	....	....
550	.009	....	....	....
560	.013	....	....	....
570	.024	....	....	....
580	.053	.004	....	....
590	.103	.019	.001	....
600	.157	.042	.007	....
610	.203	.066	.013	....
620	.267	.107	.032	.007
630	.377	.197	.085	.031
640	.518	.337	.199	.103
650	.645	.504	.366	.247
660	.747	.637	.538	.425
670	.800	.728	.656	.566
680	.830	.773	.720	.648
690	.843	.797	.751	.693
700	.851	.808	.770	.717
710	.856	.816	.782	.733
720	.858	.822	.790	.746
730	.860	.828	.799	.756
740	.863	.832	.805	.764
750	.865	.836	.811	.772
760	.867	.838	.815	.779

Table 4d

SPECTRAL TRANSMISSION DATA YELLOW 1 WEDGE

λ	2.0Y1	10.5Y1	19.0Y1	27.5Y1
380	.629	.363	.166	.064
390	.645	.382	.184	.074
400	.646	.379	.179	.073
410	.647	.381	.180	.071
420	.655	.396	.193	.079
430	.666	.409	.207	.089
440	.679	.427	.222	.099
450	.696	.458	.251	.120
460	.720	.510	.307	.163
470	.757	.578	.387	.234
480	.796	.662	.496	.345
490	.836	.744	.622	.490
500	.867	.810	.728	.633
510	.887	.851	.804	.742
520	.898	.874	.850	.809
530	.905	.887	.876	.848
540	.907	.896	.890	.873
550	.908	.899	.899	.887
560	.909	.901	.904	.895
570	.910	.903	.907	.900
580	.911	.906	.912	.906
590	.911	.906	.912	.907
600	.910	.904	.911	.907
610	.909	.903	.911	.908
620	.909	.905	.912	.909
630	.910	.905	.912	.910
640	.909	.905	.913	.911
650	.909	.905	.914	.911
660	.908	.903	.913	.911
670	.907	.903	.912	.911
680	.906	.903	.912	.911
690	.906	.902	.912	.911
700	.905	.901	.911	.910
710	.903	.900	.910	.909
720	.902	.899	.910	.909
730	.901	.899	.910	.908
740	.901	.898	.909	.907
750	.901	.898	.909	.907
760	.901	.898	.909	.907

Table 4e

SPECTRAL TRANSMISSION DATA YELLOW 2 WEDGE

λ	2.0Y2	10.5Y2	19.0Y2	27.5Y2
380	.148	.001	....	....
390	.157	.001	....	....
400	.144	.001	....	....
410	.141	.002	....	....
420	.151	.002	....	....
430	.163	.002	....	....
440	.177	.003	....	....
450	.205	.007	....	....
460	.261	.017	.002	....
470	.341	.039	.009	.001
480	.454	.099	.036	.010
490	.588	.230	.117	.054
500	.709	.414	.279	.180
510	.792	.588	.472	.374
520	.842	.702	.529	.549
530	.869	.781	.729	.669
540	.887	.831	.798	.760
550	.897	.862	.843	.816
560	.902	.878	.869	.852
570	.905	.889	.886	.872
580	.908	.896	.894	.885
590	.910	.899	.899	.891
600	.909	.899	.900	.895
610	.908	.899	.902	.897
620	.908	.900	.903	.898
630	.909	.901	.904	.899
640	.909	.902	.904	.900
650	.908	.902	.905	.900
660	.908	.901	.904	.900
670	.907	.900	.904	.900
680	.907	.900	.904	.900
690	.906	.900	.904	.900
700	.906	.900	.904	.900
710	.905	.899	.903	.900
720	.905	.899	.903	.900
730	.904	.899	.903	.900
740	.904	.899	.902	.900
750	.903	.898	.902	.900
760	.903	.898	.902	.900

Table 4f

SPECTRAL TRANSMISSION DATA YELLOW 3 WEDGE

λ	2.0Y3	10.5Y3	19.0Y3	27.5Y3
380	....	....	....	....
390	....	....	....	....
400	....	....	....	....
410	....	....	....	....
420	....	....	....	....
430	....	....	....	....
440	....	....	....	....
450	....	....	....	....
460	....	....	....	....
470	.004	....	....	....
480	.025	....	....	....
490	.039	.002	....	....
500	.239	.044	.008	....
510	.434	.176	.068	.023
520	.594	.350	.210	.110
530	.703	.510	.375	.260
540	.780	.641	.533	.426
550	.828	.733	.565	.576
560	.858	.799	.755	.697
570	.874	.838	.810	.769
580	.885	.858	.842	.813
590	.890	.868	.859	.838
600	.891	.875	.869	.852
610	.892	.878	.878	.862
620	.893	.882	.882	.868
630	.895	.883	.886	.875
640	.896	.885	.889	.878
650	.897	.888	.892	.881
660	.896	.887	.892	.883
670	.895	.886	.893	.883
680	.895	.885	.892	.883
690	.895	.885	.894	.885
700	.895	.888	.897	.890
710	.895	.888	.898	.892
720	.895	.888	.900	.895
730	.895	.888	.900	.895
740	.895	.888	.900	.895
750	.895	.888	.901	.896
760	.895	.888	.902	.897

Table 4g

SPECTRAL TRANSMISSION DATA CYAN 1 WEDGE

λ	2.0C1	10.5C1	19.0C1	27.5C1
380	.801	.700	.612	.509
390	.829	.736	.658	.570
400	.846	.768	.703	.625
410	.857	.794	.742	.677
420	.864	.810	.765	.709
430	.867	.818	.777	.720
440	.868	.819	.778	.726
450	.869	.820	.780	.727
460	.870	.822	.782	.728
470	.872	.824	.784	.731
480	.873	.825	.785	.731
490	.872	.823	.78[illegible]	.723
500	.870	.817	[illegible]	.713
[illegible]	[illegible]	.809	.761	.698
520	.862	.793	.735	.664
530	.852	.773	.705	.626
540	842	.750	.669	.584
550	.832	.724	.633	.538
560	.813	.688	.584	.475
570	.794	.644	.524	.411
580	.781	.615	485	.371
590	.773	.602	.468	.351
600	.760	.570	.432	.313
610	.735	.514	.369	.249
620	.703	.465	.313	.198
630	.691	.448	.298	.183
640	.716	.495	.348	.229
650	.738	.523	.378	.258
660	.718	.498	.348	.227
670	.700	.453	.299	.182
680	.665	.405	.249	.143
690	.690	.449	.303	.188
700	.774	.605	.489	.372
710	.827	.722	.640	.547
720	.850	.784	.724	.655
730	.866	.818	.777	.722
740	.876	.844	.818	.777
750	.883	.862	.849	.821
760	.889	.874	.869	.849

Table 4h

SPECTRAL TRANSMISSION DATA CYAN 2 WEDGE

λ	2.0C2	10.5C2	19.0C2	27.5C2
380	.652	.470	.331	.193
390	.683	.502	.367	.224
400	.705	.541	.408	.266
410	.734	.586	.463	.322
420	.754	.618	.500	.363
430	.756	.628	.512	.375
440	.758	.628	.513	.375
450	.757	.628	.500	.374
460	.757	.625	.508	.369
470	.758	.626	.508	.370
480	.759	.627	.509	.370
490	.756	.615	.493	.353
500	.745	.598	.470	.328
510	.732	.581	.452	.308
520	.712	.545	.403	.257
530	.677	.484	.339	.194
540	.640	.430	.280	.145
550	.602	.389	.238	.114
560	.554	.327	.179	.072
570	.494	.258	.125	.041
580	.451	.214	.094	.027
590	.434	.194	.081	.021
600	.399	.163	.062	.013
610	.340	.119	.038	.005
620	.287	.082	.020	.001
630	.268	.072	.017	.001
640	.312	.098	.028	.003
650	.348	.124	.039	.007
660	.329	.111	.033	....
670	.288	.084	.021	....
680	.239	.057	.011	....
690	.277	.074	.019	.001
700	.439	.202	.088	.029
710	.593	.376	.236	.122
720	.684	.506	.372	.238
730	.741	.598	.482	.348
740	.783	.674	.583	.462
750	.823	.745	.674	.582
760	.848	.795	.749	.678

Table 4i

SPECTRAL TRANSMISSION DATA CYAN 3 WEDGE

λ	2.0C3	10.5C3	19.0C3	27.5C3
380	.468	.167	.054	.022
390	.501	.195	.070	.032
400	.540	.238	.096	.048
410	.585	.292	.138	.077
420	.615	.334	.163	.103
430	.625	.347	.186	.111
440	.625	.348	.187	.111
450	.625	.345	.185	.109
460	.621	.340	.179	.106
470	.622	.340	.180	.107
480	.624	.343	.181	.108
490	.612	.326	.167	.095
500	.595	.300	.147	.079
510	.581	.283	.132	.068
520	.544	.237	.099	.046
530	.482	.174	.061	.022
540	.428	.127	.036	.011
550	.388	.098	.023	.004
560	.324	.061	.009	....
570	.256	.032	....	....
580	.212	.019	....	....
590	.192	.015	....	....
600	.162	.009	....	....
610	.118	.002	....	....
620	.081	....	....	....
630	.071	....	....	....
640	.098	.001	....	....
650	.123	.003	....	....
660	.109	....	....	....
670	.083	....	....	....
680	.057	....	....	....
690	.074	....	....	....
700	.195	.018	....	....
710	.372	.091	.018	.004
720	.502	.201	.069	.033
730	.594	.309	.148	.088
740	.673	.427	.254	.180
750	.741	.549	.387	.312
760	.792	.648	.521	.449

Table 4j

SPECTRAL TRANSMISSION DATA NEUTRAL WEDGE

λ	2.0Nu	10.5Nu	19.0Nu	27.5Nu
380	.718	.448	.250	.116
390	.745	.499	.303	.155
400	.765	.538	.345	.192
410	.775	.563	.379	.221
420	.782	.582	.402	.246
430	.788	.588	.421	.264
440	.791	.609	.436	.280
450	.797	.617	.447	.292
460	.800	.625	.454	.300
470	.803	.629	.460	.306
480	.806	.633	.465	.311
490	.809	.635	.468	.313
500	.809	.636	.470	.317
510	.810	.640	.474	.319
520	.811	.640	.476	.322
530	.812	.641	.476	.324
540	.812	.642	.478	.326
550	.812	.642	.475	.328
560	.810	.641	.474	.327
570	.810	.640	.469	.325
580	.810	.639	.470	.325
590	.811	.639	.472	.327
600	.809	.639	.473	.328
610	.807	.640	.477	.329
620	.810	.643	.479	.331
630	.811	.648	.484	.333
640	.814	.650	.488	.337
650	.816	.655	.492	.340
660	.816	.655	.495	.343
670	.815	.655	.498	.347
680	.814	.655	.500	.349
690	.813	.656	.502	.351
700	.812	.657	.505	.354
710	.811	.657	.506	.357
720	.810	.658	.508	.358
730	.810	.658	.510	.360
740	.810	.658	.511	.362
750	.810	.659	.515	.364
760	.810	.660	.517	.368

Table 5

FILM CALIBRATION EXPOSURE DATA

C.I. No.	Exposure Series	Wedges				f-stop		Capacitance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
1	1	2.0-1	2.0-1	2.0-1	2.0	1.4	2.8	480	.4249	.4012	.6932
2	1	2.0-1	2.0-1	2.0-1	2.0	1.4	2.8	240	.....	.....	.....
3	1	2.0-1	2.0-1	2.0-1	2.0	2	4	240	.....	.....	.....
4	1	2.0-1	2.0-1	2.0-1	2.0	2.8	5.6	240	.4265	.4000	.6739
5	1	2.0-1	2.0-1	2.0-1	2.0	4	8	240	.4293	.3982	.6493
6	1	2.0-1	2.0-1	2.0-1	2.0	5.6	11	240	.4280	.3968	.5728
7	1	2.0-1	2.0-1	2.0-1	2.0	8	16	240	.4116	.3918	.3972
8	1	2.0-1	2.0-1	2.0-1	2.0	11	22	240	.4017	.3889	.2293
9	1	2.0-1	2.0-1	2.0-1	2.0	16	32	240	.3943	.3801	.0899
10	2	2.0-1	20.1-1	2.0-1	2.0	1.4	2.8	480	.4238	.4011	.6994
11	2	2.0-1	20.1-1	2.0-1	2.0	1.4	2.8	240	.....	.....	.....
12	2	2.0-1	20.1-1	2.0-1	2.0	2	4	240	.....	.....	.....
13	2	2.0-1	20.1-1	2.0-1	2.0	2.8	5.6	240	.4273	.4028	.6826
14	2	2.0-1	20.1-1	2.0-1	2.0	4	8	240	.4330	.4052	.6281
15	2	2.0-1	20.1-1	2.0-1	2.0	5.6	11	240	.4435	.4128	.5387
16	2	2.0-1	20.1-1	2.0-1	2.0	8	16	240	.4519	.4311	.3590
17	2	2.0-1	20.1-1	2.0-1	2.0	11	22	240	.4566	.4391	.1944
18	2	2.0-1	20.1-1	2.0-1	2.0	16	32	240	.4724	.4397	.0680
19	3	21.2-1	20.1-1	2.0-1	2.0	1.4	2.8	480	.4247	.4019	.6884
20	3	21.2-1	20.1-1	2.0-1	2.0	1.4	2.8	240	.....	.....	.....
21	3	21.2-1	20.1-1	2.0-1	2.0	2	4	240	.....	.....	.....
22	3	21.2-1	20.1-1	2.0-1	2.0	2.8	5.6	240	.4320	.3964	.6186
23	3	21.2-1	20.1-1	2.0-1	2.0	4	8	240	.4441	.3329	.5191
24	3	21.2-1	20.1-1	2.0-1	2.0	5.6	11	240	.4644	.3910	.3591
25	3	21.2-1	20.1-1	2.0-1	2.0	8	16	240	.4916	.3842	.1700
26	3	21.2-1	20.1-1	2.0-1	2.0	11	22	240	.5142	.3737	.0685
27	3	21.2-1	20.1-1	2.0-1	2.0	16	32	240	.5488	.3679	.0171

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac-itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
28	4	21.2-1	2.0-1	2.0-1	2.0	1.4	2.8	480	.4246	.4015	.6887
29	4	21.2-1	2.0-1	2.0-1	2.0	1.4	2.8	240	.....	.....	.....
30	4	21.2-1	2.0-1	2.0-1	2.0	2	4	240	.....	.....	.....
31	4	21.2-1	2.0-1	2.0-1	2.0	2.8	5.6	240	.4305	.3981	.6405
32	4	21.2-1	2.0-1	2.0-1	2.0	4	8	240	.4375	.3886	.5653
33	4	21.2-1	2.0-1	2.0-1	2.0	5.6	11	240	.4420	.3677	.3801
34	4	21.2-1	2.0-1	2.0-1	2.0	8	16	240	.4343	.3423	.1921
35	4	21.2-1	2.0-1	2.0-1	2.0	11	22	240	.4304	.3227	.0795
36	4	21.2-1	2.0-1	2.0-1	2.0	16	32	240	.4277	.2976	.0238
37	5	21.2-1	2.0-1	18.7-1	2.0	1.4	2.8	480	.4114	.4055	.7240
38	5	21.2-1	2.0-1	18.7-1	2.0	1.4	2.8	240	.....	.....	.....
39	5	21.2-1	2.0-1	18.7-1	2.0	2	4	240	.4290	.3987	.6494
40	5	21.2-1	2.0-1	18.7-1	2.0	2.8	5.6	240	.4328	.3927	.6034
41	5	21.2-1	2.0-1	18.7-1	2.0	4	8	240	.4325	.3997	.4627
42	5	21.2-1	2.0-1	18.7-1	2.0	5.6	11	240	.4156	.3591	.2726
43	5	21.2-1	2.0-1	18.7-1	2.0	8	16	240	.3900	.3254	.1108
44	5	21.2-1	2.0-1	18.7-1	2.0	11	22	240	.3681	.2973	.0385
45	5	21.2-1	2.0-1	18.7-1	2.0	16	32	240	.3151	.2510	.0073
46	6	2.0-1	2.0-1	13.7-1	2.0	1.4	2.8	480	.4243	.4012	.6907
47	6	2.0-1	2.0-1	18.7-1	2.0	1.4	2.8	240	.....	.....	.....
48	6	2.0-1	2.0-1	18.7-1	2.0	2	4	240	.....	.....	.....
49	6	2.0-1	2.0-1	18.7-1	2.0	2.8	5.6	240	.....	.....	.....
50	6	2.0-1	2.0-1	18.7-1	2.0	4	8	240	.4245	.3993	.6134
51	6	2.0-1	2.0-1	18.7-1	2.0	5.6	11	240	.4050	.3975	.4717
52	6	2.0-1	2.0-1	18.7-1	2.0	8	16	240	.3782	.3931	.2868
53	6	2.0-1	2.0-1	18.7-1	2.0	11	22	240	.3621	.3855	.1396
54	6	2.0-1	2.0-1	18.7-1	2.0	16	32	240	.3299	.3843	.0441

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac-itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
55	7	2.0-1	2001-1	18.7-1	2.0	1.4	2.8	480	.4254	.4018	.6952
56	7	2.0-1	20.1-1	18.7-1	2.0	1.4	2.8	240	.....	.....	.....
57	7	2.0-1	20.1-1	18.7-1	2.0	2	4	240	.....	.....	.....
58	7	2.0-1	20.1-1	18.7-1	2.0	2.8	5.6	240	.4297	.4023	.6592
59	7	2.0-1	20.1-1	18.7-1	2.0	4	8	240	.4299	.4074	.5920
60	7	2.0-1	20.1-1	18.7-1	2.0	5.6	11	240	.4233	.4200	.4462
61	7	2.0-1	20.1-1	18.7-1	2.0	8	16	240	.4259	.4412	.2650
62	7	2.0-1	20.1-1	18.7-1	2.0	11	22	240	.4237	.4472	.1152
63	7	2.0-1	20.1-1	18.7-1	2.0	16	32	240	.4191	.4588	.0309
64	8	2.0-1	15.5-2	2.0-1	2.0	1.4	2.8	480	.4431	.4100	.5956
65	8	2.0-1	15.5-2	2.0-1	2.0	1.4	2.8	240	.4644	.4276	.5490
66	8	2.0-1	15.5-2	2.0-1	2.0	2	4	240	.4907	.4426	.4817
67	8	2.0-1	15.5-2	2.0-1	2.0	2.8	5.6	240	.5158	.4475	.4030
68	8	2.0-1	15.5-2	2.0-1	2.0	4	8	240	.5380	.4442	.3061
69	8	2.0-1	15.5-2	2.0-1	2.0	5.6	11	240	.5504	.4382	.2268
70	8	2.0-1	15.5-2	2.0-1	2.0	8	16	240	.5522	.4361	.1211
71	8	2.0-1	15.5-2	2.0-1	2.0	11	22	240	.5565	.4322	.0599
72	8	2.0-1	15.5-2	2.0-1	2.0	16	32	240	.5616	.4268	.0237
73	9	21.2-1	15.5-2	2.0-1	2.0	1.4	2.8	480	.4605	.4257	.5717
74	9	21.2-1	15.5-2	2.0-1	2.0	1.4	2.8	240	.4904	.4423	.4948
75	9	21.2-1	15.5-2	2.0-1	2.0	2	4	240	.5159	.4470	.4113
76	9	21.2-1	15.5-2	2.0-1	2.0	2.8	5.6	240	.5371	.4433	.3171
77	9	21.2-1	15.5-2	2.0-1	2.0	4	8	240	.5576	.4316	.2167
78	9	21.2-1	15.5-2	2.0-1	2.0	5.6	11	240	.5799	.4109	.1271
79	9	21.2-1	15.5-2	2.0-1	2.0	8	16	240	.6055	.3871	.0546
80	9	21.2-1	15.5-2	2.0-1	2.0	11	22	240	.6164	.3775	.0229
81	9	21.2-1	15.5-2	2.0-1	2.0	16	32	240	.....	.....	.....

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac-itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
82	10	15.1-2	15.5-2	2.0-1	2.0	1.4	2.8	480	.4841	.4410	.5149
83	10	15.1-2	15.5-2	2.0-1	2.0	1.4	2.8	240	.5133	.4461	.4126
84	10	15.1-2	15.5-2	2.0-1	2.0	2	4	240	.5413	.4378	.2977
85	10	15.1-2	15.5-2	2.0-1	2.0	2.8	5.6	240	.5674	.4201	.1951
86	10	15.1-2	15.5-2	2.0-1	2.0	4	8	240	.6141	.3781	.0894
87	10	15.1-2	15.5-2	2.0-1	2.0	5.6	11	240	.6485	.3454	.0427
88	10	15.1-2	15.5-2	2.0-1	2.0	8	16	240	.6799	.3159	.0178
89	10	15.1-2	15.5-2	2.0-1	2.0	11	22	240	.6877	.3122	.0078
90	10	15.1-2	15.5-2	2.0-1	2.0	16	32	240	.6939	[illegible]	.0024
91	11	15.1-2	20.1-1	2.0-1	2.0	1.4	2.8	480	.4271	.3992	.6654
92	11	15.1-2	20.1-1	2.0-1	2.0	1.4	2.8	240	.4300	.3962	.6336
93	11	15.1-2	20.1-1	2.0-1	2.0	2	4	240	.4362	.3884	.5590
94	11	15.1-2	20.1-1	2.0-1	2.0	2.8	5.6	240	.4507	.3718	.4341
95	11	15.1-2	20.1-1	2.0-1	2.0	4	8	240	.4810	.3441	.2632
96	11	15.1-2	20.1-1	2.0-1	2.0	5.6	11	240	.5248	.3268	.1291
97	11	15.1-2	20.1-1	2.0-1	2.0	8	16	240	.5684	.3121	.0469
98	11	15.1-2	20.1-1	2.0-1	2.0	11	22	240	.6113	.2947	.0150
99	11	15.1-2	20.1-1	2.0-1	2.0	16	32	240	.6675	.3110	.0040
100	12	15.1-2	2.0-1	2.0-1	2.0	1.4	2.8	480	.4263	.3994	.6712
101	12	15.1-2	2.0-1	2.0-1	2.0	1.4	2.8	240	.4288	.3969	.6452
102	12	15.1-2	2.0-1	2.0-1	2.0	2	4	240	.4344	.3892	.5792
103	12	15.1-2	2.0-1	2.0-1	2.0	2.8	5.6	240	.4461	.3727	.4541
104	12	15.1-2	2.0-1	2.0-1	2.0	4	8	240	.4681	.3384	.2830
105	12	15.1-2	2.0-1	2.0-1	2.0	5.6	11	240	.4738	.3009	.1480
106	12	15.1-2	2.0-1	2.0-1	2.0	8	16	240	.4727	.2687	.0567
107	12	15.1-2	2.0-1	2.0-1	2.0	11	22	240	.4787	.2514	.0194
108	12	15.1-2	2.0-1	2.0-1	2.0	16	32	240	.4591	.2250	.0046

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac-itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
109	13	15.1-2	2.0-1	18.7-1	2.0	1.4	2.8	480	.4278	.3983	.6633
110	13	15.1-2	2.0-1	18.7-1	2.0	1.4	2.8	240	.4314	.3946	.6135
111	13	15.1-2	2.0-1	18.7-1	2.0	2	4	240	.4394	.3831	.5397
112	13	15.1-2	2.0-1	18.7-1	2.0	2.8	5.6	240	.4557	.3613	.3951
113	13	15.1-2	2.0-1	18.7-1	2.0	4	8	240	.4618	.3226	.2125
114	13	15.1-2	2.0-1	18.7-1	2.0	5.6	11	240	.4464	.2842	.0955
115	13	15.1-2	2.0-1	18.7-1	2.0	8	16	240	.4228	.2429	.0292
116	13	15.1-2	2.0-1	18.7-1	2.0	11	22	240	.3842	.1920	.0062
117	13	15.1-2	2.0-1	18.7-1	2.0	16	32	240	.1774	.0722	.0003
118	14	15.1-2	2.0-1	12.4-2	2.0	1.4	2.8	480	.4300	.3968	.6439
119	14	15.1-2	2.0-1	12.4-2	2.0	1.4	2.8	240	.4360	.3858	.5507
120	14	15.1-2	2.0-1	12.4-2	2.0	2	4	240	.4313	.3659	.3697
121	14	15.1-2	2.0-1	12.4-2	2.0	2.8	5.6	240	.4079	.3292	.1389
122	14	15.1-2	2.0-1	12.4-2	2.0	4	8	240	.3598	.2707	.0706
123	14	15.1-2	2.0-1	12.4-2	2.0	5.6	11	240	.2765	.1936	.0183
124	14	15.1-2	2.0-1	12.4-2	2.0	8	16	240	.1384	.0714	.0015
125	14	15.1-2	2.0-1	12.4-2	2.0	11	22	240	.1338	.0605	.0004
126	14	15.1-2	2.0-1	12.4-2	2.0	16	32	240	.1264	.0759	.0001
127	15	21.2-1	2.0-1	12.4-2	2.0	1.4	2.8	480	.4272	.4017	.6821
128	15	21.2-1	2.0-1	12.4-2	2.0	1.4	2.8	240	.4293	.3996	.6583
129	15	21.2-1	2.0-1	12.4-2	2.0	2	4	240	.4215	.3978	.5789
130	15	21.2-1	2.0-1	12.4-2	2.0	2.8	5.6	240	.3981	.3887	.4074
131	15	21.2-1	2.0-1	12.4-2	2.0	4	8	240	.3611	.3619	.2237
132	15	21.2-1	2.0-1	12.4-2	2.0	5.6	11	240	.3125	.3094	.0923
133	15	21.2-1	2.0-1	12.4-2	2.0	8	16	240	.2424	.2438	.0243
134	15	21.2-1	2.0-1	12.4-2	2.0	11	22	240	.1692	.1749	.0045
135	15	21.2-1	2.0-1	12.4-2	2.0	16	32	240	.1189	.1065	.0005

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac-itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
136	16	2.0-1	2.0-1	12.4-2	2.0	1.4	2.8	480	.4253	.4024	.6787
137	16	2.0-1	2.0-1	12.4-2	2.0	1.4	2.8	240	.....	.....	.....
138	16	2.0-1	2.0-1	12.4-2	2.0	2	4	240	.4228	.4021	.6414
139	16	2.0-1	2.0-1	12.4-2	2.0	2.8	5.6	240	.4009	.4045	5253
140	16	2.0-1	2.0-1	12.4-2	2.0	4	8	240	.3678	.4023	.3990
141	16	2.0-1	2.0-1	12.4-2	2.0	5.6	11	240	.3269	.3892	.2363
142	16	2.0-1	2.0-1	12.4-2	2.0	8	16	240	.2779	.3582	.0964
143	16	2.0-1	2.0-1	12.4-2	2.0	11	22	240	.2240	.3241	.0298
144	16	2.0-1	2.0-1	12.4-2	2.0	16	32	240	.1375	.2332	.0043
145	17	2.0-1	20.1-1	12.4-2	2.0	1.4	2.8	480	.4251	.4018	.6953
146	17	2.0-1	20.1-1	12.4-2	2.0	1.4	2.8	240	.....	.....	.....
147	17	2.0-1	20.1-1	12.4-2	2.0	2	4	240	.4274	.4015	.6578
148	17	2.0-1	20.1-1	12.4-2	2.0	2.8	5.6	240	.4060	.4087	.5661
149	17	2.0-1	20.1-1	12.4-2	2.0	4	8	240	.3768	.4181	.4035
150	17	2.0-1	20.1-1	12.4-2	2.0	5.6	11	240	.3504	.4232	.2421
151	17	2.0-1	20.1-1	12.4-2	2.0	8	16	240	.3317	.4487	.0889
152	17	2.0-1	20.1-1	12.4-2	2.0	11	22	240	.2918	.4440	.0236
153	17	2.0-1	20.1-1	12.4-2	2.0	16	32	240	.2307	.4707	.0037
154	18	2.0-1	15.5-2	12.4-2	2.0	1.4	2.8	480	.4555	.4217	.5847
155	18	2.0-1	15.5-2	12.4-2	2.0	1.4	2.8	240	.4815	.4406	.5218
156	18	2.0-1	15.5-2	12.4-2	2.0	2	4	240	.5022	.4506	.4250
157	18	2.0-1	15.5-2	12.4-2	2.0	2.8	5.6	240	.5087	.4635	.2949
158	18	2.0-1	15.5-2	12.4-2	2.0	4	8	240	.4963	.4843	.1624
159	18	2.0-1	15.5-2	12.4-2	2.0	5.6	11	240	.4790	.4983	.0691
160	18	2.0-1	15.5-2	12.4-2	2.0	8	16	240	.4576	.5063	.0216
161	18	2.0-1	15.5-2	12.4-2	2.0	11	22	240	.3917	.5311	.0066
162	18	2.0-1	15.5-2	12.4-2	2.0	16	32	240	.7248	.5087	.0003

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac-itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
163	19	2.0-1	15.5-2	18.7-1	2.0	1.4	2.8	480	.4454	.4147	.6063
164	19	2.0-1	15.5-2	18.7-1	2.0	1.4	2.8	240	.4705	.4333	.5515
165	19	2.0-1	15.5-2	18.7-1	2.0	2	4	240	.4958	.4457	.4851
166	19	2.0-1	15.5-2	18.7-1	2.0	2.8	5.6	240	.5196	.4480	.3937
167	19	2.0-1	15.5-2	18.7-1	2.0	4	8	240	.5379	.4458	.2889
168	19	2.0-1	15.5-2	18.7-1	2.0	5.6	11	240	.5346	.4520	.1880
169	19	2.0-1	15.5-2	18.7-1	2.0	8	16	240	.5288	.4561	.0889
170	19	2.0-1	15.5-2	18.7-1	2.0	11	22	240	.5255	.4566	.0371
171	19	2.0-1	15.5-2	18.7-1	2.0	16	32	240	.4992	.4737	.0128
172	20	2.0-1	9.4-3	2.0-1	2.0	1.4	2.8	480	.5085	.4463	.4396
173	20	2.0-1	9.4-3	2.0-1	2.0	1.4	2.8	240	.5348	.4446	.3275
174	20	2.0-1	9.4-3	2.0-1	2.0	2	4	240	.5528	.4367	.2451
175	20	2.0-1	9.4-3	2.0-1	2.0	2.8	5.6	240	.5595	.4307	.1926
176	20	2.0-1	9.4-3	2.0-1	2.0	4	8	240	.5626	.4278	.1708
177	20	2.0-1	9.4-3	2.0-1	2.0	5.6	11	240	.5634	.4266	.1557
178	20	2.0-1	9.4-3	2.0-1	2.0	8	16	240	.5625	.4271	.1055
179	20	2.0-1	9.4-3	2.0-1	2.0	11	22	240	.5627	.4260	.0582
180	20	2.0-1	9.4-3	2.0-1	2.0	16	32	240	.5764	.4125	.0201
181	21	21.2-1	9.4-3	2.0-1	2.0	1.4	2.8	480	.5423	.4419	.2904
182	21	21.2-1	9.4-3	2.0-1	2.0	1.4	2.8	240	.5527	.4362	.2250
183	21	21.2-1	9.4-3	2.0-1	2.0	2	4	240	.5620	.4285	.1746
184	21	21.2-1	9.4-3	2.0-1	2.0	2.8	5.6	240	.5689	.4222	.1463
185	21	21.2-1	9.4-3	2.0-1	2.0	4	8	240	.57[illegible]7	.4149	.1310
186	21	21.2-1	9.4-3	2.0-1	2.0	5.6	11	240	.5966	.3967	.0912
187	21	21.2-1	9.4-3	2.0-1	2.0	8	16	240	.6206	.3736	.0450
188	21	21.2-1	9.4-3	2.0-1	2.0	11	22	240	.6399	.3561	.0192
189	21	21.2-1	9.4-3	2.0-1	2.0	16	32	240	.6743	.3254	.0052

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges: Magenta	Wedges: Yellow	Wedges: Cyan	Wedges: Neutral	f-stop: Indicated	f-stop: Actual	Capac-itance	Chromaticity Data: x	Chromaticity Data: y	Chromaticity Data: L
190	22	15.1-2	9.4-3	2.0-1	2.0	1.4	2.8	480	.5568	.4327	.2024
191	22	15.1-2	9.4-3	2.0-1	2.0	1.4	2.8	240	.5623	.4284	.1711
192	22	15.1-2	9.4-3	2.0-1	2.0	2	4	240	.5710	.4200	.1457
193	22	15.1-2	9.4-3	2.0-1	2.0	2.8	5.6	240	.5905	.4019	.1093
194	22	15.1-2	9.4-3	2.0-1	2.0	4	8	240	.6295	.3661	.0700
195	22	15.1-2	9.4-3	2.0-1	2.0	5.6	11	240	.6597	.3375	.0394
196	22	15.1-2	9.4-3	2.0-1	2.0	8	16	240	.6844	.3154	.0172
197	22	15.1-2	9.4-3	2.0-1	2.0	11	22	240	.6949	.3049	.0072
198	22	15.1-2	9.4-3	2.0-1	2.0	16	32	240	.6915	.3083	.0026
199	23	8.3-3	9.4-3	2.0-1	2.0	1.4	2.8	480	.6261	.3677	.0730
200	23	8.3-3	9.4-3	2.0-1	2.0	1.4	2.8	240	.6726	.3259	.0357
201	23	8.3-3	9.4-3	2.0-1	2.0	2	4	240	.6925	.3073	.0220
202	23	8.3-3	9.4-3	2.0-1	2.0	2.8	5.6	240	.7023	.2975	.0167
203	23	8.3-3	9.4-3	2.0-1	2.0	4	8	240	.7036	.2963	.0149
204	23	8.3-3	9.4-3	2.0-1	2.0	5.6	11	240	.7039	.2960	.0130
205	23	8.3-3	9.4-3	2.0-1	2.0	8	16	240	.7011	.2988	.0079
206	23	8.3-3	9.4-3	2.0-1	2.0	11	22	240	.....	.....	.....
207	23	8.3-3	9.4-3	2.0-1	2.0	16	32	240	.....	.....	.....
208	24	8.3-3	15.5-2	2.0-1	2.0	1.4	2.8	480	.5857	.3883	.16[illegible]5
209	24	8.3-3	15.5-2	2.0-1	2.0	1.4	2.8	240	.6471	.3455	.0687
210	24	8.3-3	15.5-2	2.0-1	2.0	2	4	240	.6867	.3131	.0303
211	24	8.3-3	15.5-2	2.0-1	2.0	2.8	5.6	240	.6944	.3055	.0210
212	24	8.3-3	15.5-2	2.0-1	2.0	4	8	240	.7030	.2969	.0154
213	24	8.3-3	15.5-2	2.0-1	2.0	5.6	11	240	.7086	.2913	.0127
214	24	8.3-3	15.5-2	2.0-1	2.0	8	16	240	.7004	.2995	.0081
215	24	8.3-3	15.5-2	2.0-1	2.0	11	22	240	.....	.....	.....
216	24	8.3-3	15.5-2	2.0-1	2.0	16	32	240	.....	.....	.....

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac- itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
217	25	8.3-3	20.1-1	2.0-1	2.0	1.4	2.8	480	.4592	.3568	.3386
218	25	8.3-3	20.1-1	2.0-1	2.0	1.4	2.8	240	.4910	.3140	.2205
219	25	8.3-3	20.1-1	2.0-1	2.0	2	4	240	.5290	.2818	.1184
220	25	8.3-3	20.1-1	2.0-1	2.0	2.8	5.6	240	.5271	.2645	.0674
221	25	8.3-3	20.1-1	2.0-1	2.0	4	8	240	.6145	.2641	.0388
222	25	8.3-3	20.1-1	2.0-1	2.0	5.6	11	240	.6525	.2759	.0261
223	25	8.3-3	20.1-1	2.0-1	2.0	8	16	240	.6696	.2863	.0130
224	25	8.3-3	20.1-1	2.0-1	2.0	11	22	240	.6948	.3050	.0058
225	25	8.3-3	20.1-1	2.0-1	2.0	16	32	240	.6898	.3100	.0008
226	26	8.3-3	2.0-1	2.0-1	2.0	1.4	2.8	480	.4471	.3739	.4736
227	26	8.3-3	2.0-1	2.0-1	2.0	1.4	2.8	240	.4716	.3389	.3003
228	26	8.3-3	2.0-1	2.0-1	2.0	2	4	240	.5009	.2997	.1691
229	26	8.3-3	2.0-1	2.0-1	2.0	2.8	5.6	240	.5376	.2715	.0961
230	26	8.3-3	2.0-1	2.0-1	2.0	4	8	240	.5213	.2260	.0475
231	26	8.3-3	2.0-1	2.0-1	2.0	5.6	11	240	.5741	.2463	.0286
232	26	8.3-3	2.0-1	2.0-1	2.0	8	16	240	.5732	.2426	.0146
233	26	8.3-3	2.0-1	2.0-1	2.0	11	22	240	.5488	.2366	.0061
234	26	8.3-3	2.0-1	2.0-1	2.0	16	32	240	.4409	.1981	.0011
235	27	8.3-3	2.0-1	18.7-1	2.0	1.4	2.8	480	.4540	.3651	.4279
236	27	8.3-3	2.0-1	18.7-1	2.0	1.4	2.8	240	.4817	.3239	.2491
237	27	8.3-3	2.0-1	18.7-1	2.0	2	4	240	.5159	.2890	.1402
238	27	8.3-3	2.0-1	18.7-1	2.0	2.8	5.6	240	.5499	.2641	.0748
239	27	8.3-3	2.0-1	18.7-1	2.0	4	8	240	.5589	.2461	.0359
240	27	8.3-3	2.0-1	18.7-1	2.0	5.6	11	240	.5383	.2299	.0170
241	27	8.3-3	2.0-1	18.7-1	2.0	8	16	240	.4799	.2065	.0064
242	27	8.3-3	2.0-1	18.7-1	2.0	11	22	240	.3372	.1447	.0014
243	27	8.3-3	2.0-1	18.7-1	2.0	16	32	240	.....	.....	.....

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac-itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
244	28	8.3-3	2.0-1	12.4-2	2.0	1.4	2.8	480	.4719	.3380	.3070
245	28	8.3-3	2.0-1	12.4-2	2.0	1.4	2.8	240	.4996	.2963	.1558
246	28	8.3-3	2.0-1	12.4-2	2.0	2	4	240	.4976	.2596	.0711
247	28	8.3-3	2.0-1	12.4-2	2.0	2.8	5.6	240	.4662	.2176	.0246
248	28	8.3-3	2.0-1	12.4-2	2.0	4	8	240	.3702	.1609	.0071
249	28	8.3-3	2.0-1	12.4-2	2.0	5.6	11	240	.2235	.0936	.0017
250	28	8.3-3	2.0-1	12.4-2	2.0	8	16	240	.....	.....	.....
251	28	8.3-3	2.0-1	12.4-2	2.0	11	22	240	.....	.....	.....
252	28	8.3-3	2.0-1	12.4-2	2.0	16	32	240	.....	.....	.....
253	29	8.3-3	2.0-1	10.8-3	2.0	1.4	2.8	480	.2967	.2460	.0478
254	29	8.3-3	2.0-1	10.8-3	2.0	1.4	2.8	240	.1971	.1341	.0091
255	29	8.3-3	2.0-1	10.8-3	2.0	2	4	240	.1356	.0617	.0017
256	29	8.3-3	2.0-1	10.8-3	2.0	2.8	5.6	240	.....	.....	.....
257	29	8.3-3	2.0-1	10.8-3	2.0	4	8	240	.....	.....	.....
258	29	8.3-3	2.0-1	10.8-3	2.0	5.6	11	240	.....	.....	.....
259	29	8.3-3	2.0-1	10.8-3	2.0	8	16	240	.....	.....	.....
260	29	8.3-3	2.0-1	10.8-3	2.0	11	22	240	.....	.....	.....
261	29	8.3-3	2.0-1	10.8-3	2.0	16	32	240	.....	.....	.....
262	30	15.1-2	2.0-1	10.8-3	2.0	1.4	2.8	480	.3413	.3917	.3142
263	30	15.1-2	2.0-1	10.8-3	2.0	1.4	2.8	240	.2873	.3429	.1450
264	30	15.1-2	2.0-1	10.8-3	2.0	2	4	240	.2273	.2616	.0480
265	30	15.1-2	2.0-1	10.8-3	2.0	2.8	5.6	240	.1635	.1655	.0131
266	30	15.1-2	2.0-1	10.8-3	2.0	4	8	240	.1304	.0833	.0029
267	30	15.1-2	2.0-1	10.8-3	2.0	5.6	11	240	.....	.....	.....
268	30	15.1-2	2.0-1	10.8-3	2.0	8	16	240	.....	.....	.....
269	30	15.1-2	2.0-1	10.8-3	2.0	11	22	240	.....	.....	.....
270	30	15.1-2	2.0-1	10.8-3	2.0	16	32	240	.....	.....	.....

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac-itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
271	31	21.2-1	2.0-1	10.8-3	2.0	1.4	2.8	480	.3675	.4106	.4918
272	31	21.2-1	2.0-1	10.8-3	2.0	1.4	2.8	240	.3154	.3981	.3135
273	31	21.2-1	2.0-1	10.8-3	2.0	2	4	240	.2705	.3749	.1805
274	31	21.2-1	2.0-1	10.8-3	2.0	2.8	5.6	240	.2048	.2394	.0679
275	31	21.2-1	2.0-1	10.8-3	2.0	4	8	240	.1663	.2143	.0221
276	31	21.2-1	2.0-1	10.8-3	2.0	5.6	11	240	.1380	.1511	.0075
277	31	21.2-1	2.0-1	10.8-3	2.0	8	16	240	.....	.....	.....
278	31	21.2-1	2.0-1	10.8-3	2.0	11	22	240	.....	.....	.....
279	31	21.2-1	2.0-1	10.8-3	2.0	16	32	240	.....	.....	.....
280	32	2.0-1	2.0-1	10.8-3	2.0	1.4	2.8	480	.3998	.4082	.6102
281	32	2.0-1	2.0-1	10.8-3	2.0	1.4	2.8	240	.3596	.4145	.4887
282	32	2.0-1	2.0-1	10.8-3	2.0	2	4	240	.3122	.4140	.3553
283	32	2.0-1	2.0-1	10.8-3	2.0	2.8	5.6	240	.2628	.3969	.2195
284	32	2.0-1	2.0-1	10.8-3	2.0	4	8	240	.2084	.3441	.0945
285	32	2.0-1	2.0-1	10.8-3	2.0	5.6	11	240	.1713	.2776	.0350
286	32	2.0-1	2.0-1	10.8-3	2.0	8	16	240	.1499	.2336	.0123
287	32	2.0-1	2.0-1	10.8-3	2.0	11	22	240	.1165	.1559	.0026
288	32	2.0-1	2.0-1	10.8-3	2.0	16	32	240	.....	.....	.....
289	33	2.0-1	20.1-1	10.8-3	2.0	1.4	2.8	480	.3950	.4096	.5967
290	33	2.0-1	20.1-1	10.8-3	2.0	1.4	2.8	240	.3524	.4161	.4687
291	33	2.0-1	20.1-1	10.8-3	2.0	2	4	240	.3056	.4182	.3349
292	33	2.0-1	20.1-1	10.8-3	2.0	2.8	5.6	240	.2582	.4106	.1939
293	33	2.0-1	20.1-1	10.8-3	2.0	4	8	240	.2133	.3945	.0770
294	33	2.0-1	20.1-1	10.8-3	2.0	5.6	11	240	.1868	.3662	.0255
295	33	2.0-1	20.1-1	10.8-3	2.0	8	16	240	.1709	.3492	.0068
296	33	2.0-1	20.1-1	10.8-3	2.0	11	22	240	.....	.....	.....
297	33	2.0-1	20.1-1	10.8-3	2.0	16	32	240	.....	.....	.....

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac-itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
298	34	2.0-1	15.5-2	10.8-3	2.0	1.4	2.8	480	.4353	.4546	.4492
299	34	2.0-1	15.5-2	10.8-3	2.0	1.4	2.8	240	.4157	.4991	.2849
300	34	2.0-1	15.5-2	10.8-3	2.0	2	4	240	.3967	.5412	.1643
301	34	2.0-1	15.5-2	10.8-3	2.0	2.8	5.6	240	.3879	.5653	.0757
302	34	2.0-1	15.5-2	10.8-3	2.0	4	8	240	.3165	.6155	.0171
303	34	2.0-1	15.5-2	10.8-3	2.0	5.6	11	240	.....	.....	.....
304	34	2.0-1	15.5-2	10.8-3	2.0	8	16	240	.....	.....	.....
305	34	2.0-1	15.5-2	10.8-3	2.0	11	22	240	.....	.....	.....
306	34	2.0-1	15.5-2	10.8-3	2.0	16	32	240	.....	.....	.....
307	35	2.0-1	9.4-3	10.8-3	2.0	1.4	2.8	480	.5057	.4740	.2014
308	35	2.0-1	9.4-3	10.8-3	2.0	1.4	2.8	240	.4710	.5036	.1058
309	35	2.0-1	9.4-3	10.8-3	2.0	2	4	240	.4238	.5439	.0607
310	35	2.0-1	9.4-3	10.8-3	2.0	2.8	5.6	240	.3643	.5812	.0274
311	35	2.0-1	9.4-3	10.8-3	2.0	4	8	240	.3273	.5805	.0094
312	35	2.0-1	9.4-3	10.8-3	2.0	5.6	11	240	.....	.....	.....
313	35	2.0-1	9.4-3	10.8-3	2.0	8	16	240	.....	.....	.....
314	35	2.0-1	9.4-3	10.8-3	2.0	11	22	240	.....	.....	.....
315	35	2.0-1	9.4-3	10.8-3	2.0	16	32	240	.....	.....	.....
316	36	2.0-1	9.4-3	12.4-2	2.0	1.4	2.8	480	.5248	.4480	.3636
317	36	2.0-1	9.4-3	12.4-2	2.0	1.4	2.8	240	.5464	.4407	.2661
318	36	2.0-1	9.4-3	12.4-2	2.0	2	4	240	.5514	.4381	.2185
319	36	2.0-1	9.4-3	12.4-2	2.0	2.8	5.6	240	.5401	.4482	.1613
320	36	2.0-1	9.4-3	12.4-2	2.0	4	8	240	.5158	.4665	.0967
321	36	2.0-1	9.4-3	12.4-2	2.0	5.6	11	240	.4959	.4847	.0532
322	36	2.0-1	9.4-3	12.4-2	2.0	8	16	240	.4679	.5036	.0159
323	36	2.0-1	9.4-3	12.4-2	2.0	11	22	240	.4029	.5477	.0032
324	36	2.0-1	9.4-3	12.4-2	2.0	16	32	240	.....	.....	.....

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capacitance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
325	37	2.0-1	9.4-3	18.7-1	2.0	1.4	2.8	480	.5135	.4479	.4126
326	37	2.0-1	9.4-3	18.7-1	2.0	1.4	2.8	240	.5376	.4438	.3050
327	37	2.0-1	9.4-3	18.7-1	2.0	2	4	240	.5509	.4379	.2329
328	37	2.0-1	9.4-3	18.7-1	2.0	2.8	5.6	240	.5586	.4311	.1813
329	37	2.0-1	9.4-3	18.7-1	2.0	4	8	240	.5631	.4265	.1457
330	37	2.0-1	9.4-3	18.7-1	2.0	5.6	11	240	.5526	.4358	.1152
331	37	2.0-1	9.4-3	18.7-1	2.0	8	16	240	.5497	.4374	.0582
332	37	2.0-1	9.4-3	18.7-1	2.0	11	22	240	.5438	.4399	.0273
333	37	2.0-1	9.4-3	18.7-1	2.0	16	32	240	.5428	.4385	.0068
334	38	2.0-1	27.5-3	2.0-1	2.0	1.4	2.8	480	.5471	.4400	.2522
335	38	2.0-1	27.5-3	2.0-1	2.0	1.4	2.8	240	.5564	.4335	.2006
336	38	2.0-1	27.5-3	2.0-1	2.0	2	4	240	.5597	.4299	.1715
337	38	2.0-1	27.5-3	2.0-1	2.0	2.8	5.6	240	.5621	.4276	.1575
338	38	2.0-1	27.5-3	2.0-1	2.0	4	8	240	.5624	.4275	.1537
339	38	2.0-1	27.5-3	2.0-1	2.0	5.6	11	240	.5694	.4207	.1315
340	38	2.0-1	27.5-3	2.0-1	2.0	8	16	240	.5704	.4189	.0910
341	38	2.0-1	27.5-3	2.0-1	2.0	11	22	240	.5805	.4082	.0452
342	38	2.0-1	27.5-3	2.0-1	2.0	16	32	240	.5888	.3986	.0165
343	39	21.2-1	27.5-3	2.0-1	2.0	1.4	2.8	480	.5579	.4317	.1851
344	39	21.2-1	27.5-3	2.0-1	2.0	1.4	2.8	240	.5627	.4267	.1593
345	39	21.2-1	27.5-3	2.0-1	2.0	2	4	240	.5625	.4269	.1550
346	39	21.2-1	27.5-3	2.0-1	2.0	2.8	5.6	240	.5658	.4239	.1472
347	39	21.2-1	27.5-3	2.0-1	2.0	4	8	240	.5804	.4106	.1198
348	39	21.2-1	27.5-3	2.0-1	2.0	5.6	11	240	.6036	.3884	.0852
349	39	21.2-1	27.5-3	2.0-1	2.0	8	16	240	.6273	.3659	.0403
350	39	21.2-1	27.5-3	2.0-1	2.0	11	22	240	.6476	.3483	.0172
351	39	21.2-1	27.5-3	2.0-1	2.0	16	32	240	.6759	.3239	.0044

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac-itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
352	40	15.1-2	27.5-3	2.0-1	2.0	1.4	2.8	480	.5658	.4246	.1528
353	40	15.1-2	27.5-3	2.0-1	2.0	1.4	2.8	240	.5669	.4236	.1490
354	40	15.1-2	27.5-3	2.0-1	2.0	2	4	240	.5774	.4137	.1283
355	40	15.1-2	27.5-3	2.0-1	2.0	2.8	5.6	240	.6003	.3921	.0969
356	40	15.1-2	27.5-3	2.0-1	2.0	4	8	240	.6393	.3549	.0569
357	40	15.1-2	27.5-3	2.0-1	2.0	5.6	11	240	.6712	.3262	.0315
358	40	15.1-2	27.5-3	2.0-1	2.0	8	16	240	.6903	.3095	.0141
359	40	15.1-2	27.5-3	2.0-1	2.0	11	22	240	.6961	.3037	.0066
360	40	15.1-2	27.5-3	2.0-1	2.0	16	32	240	.....	.....	.....
361	41	8.3-3	27.5-3	2.0-1	2.0	1.4	2.8	480	.7042	.2957	.0146
362	41	8.3-3	27.5-3	2.0-1	2.0	1.4	2.8	240	.....	.....	.....
363	41	8.3-3	27.5-3	2.0-1	2.0	2	4	240	.....	.....	.....
364	41	8.3-3	27.5-3	2.0-1	2.0	2.8	5.6	240	.....	.....	.....
365	41	8.3-3	27.5-3	2.0-1	2.0	4	8	240	.7036	.2963	.0134
366	41	8.3-3	27.5-3	2.0-1	2.0	5.6	11	240	.7029	.2970	.0097
367	41	8.3-3	27.5-3	2.0-1	2.0	8	16	240	.6987	.3012	.0044
368	41	8.3-3	27.5-3	2.0-1	2.0	11	22	240	.....	.....	.....
369	41	8.3-3	27.5-3	2.0-1	2.0	16	32	240	.....	.....	.....
370	42	27.5-3	27.5-3	2.0-1	2.0	1.4	2.8	480	.7027	.2972	.0146
371	42	27.5-3	27.5-3	2.0-1	2.0	1.4	2.8	240	.....	.....	.....
372	42	27.5-3	27.5-3	2.0-1	2.0	2	4	240	.....	.....	.....
373	42	27.5-3	27.5-3	2.0-1	2.0	2.8	5.6	240	.7025	.2974	.0134
374	42	27.5-3	27.5-3	2.0-1	2.0	4	8	240	.7023	.2976	.0107
375	42	27.5-3	27.5-3	2.0-1	2.0	5.6	11	240	.7005	.2994	.0062
376	42	27.5-3	27.5-3	2.0-1	2.0	8	16	240	.....	.....	.....
377	42	27.5-3	27.5-3	2.0-1	2.0	11	22	240	.....	.....	.....
378	42	27.5-3	27.5-3	2.0-1	2.0	16	32	240	.....	.....	.....

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac-itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
379	43	27.5-3	9.4-3	2.0-1	2.0	1.4	2.8	480	.7041	.2958	.0140
380	43	27.5-3	9.4-3	2.0-1	2.0	1.4	2.8	240	.....	.....	.....
381	43	27.5-3	9.4-3	2.0-1	2.0	2	4	240	.7053	.2946	.0135
382	43	27.5-3	9.4-3	2.0-1	2.0	2.8	5.6	240	.....	.....	.....
383	43	27.5-3	9.4-3	2.0-1	2.0	4	8	240	.....	.....	.....
384	43	27.5-3	9.4-3	2.0-1	2.0	5.6	11	240	.7012	.2987	.0068
385	43	27.5-3	9.4-3	2.0-1	2.0	8	16	240	.6950	.3048	.0025
386	43	27.5-3	9.4-3	2.0-1	2.0	11	22	240	.....	.....	.....
387	43	27.5-3	9.4-3	2.0-1	2.0	16	32	240	.....	.....	.....
388	44	27.5-3	15.5-2	2.0-1	2.0	1.4	2.8	480	.7033	.2966	.0153
389	44	27.5-3	15.5-2	2.0-1	2.0	1.4	2.8	240	.7027	.2972	.0144
390	44	27.5-3	15.5-2	2.0-1	2.0	2	4	240	.7033	.2966	.0139
391	44	27.5-3	15.5-2	2.0-1	2.0	2.8	5.6	240	.7004	.2994	.....
392	44	27.5-3	15.5-2	2.0-1	2.0	4	8	240	.7017	.2982	.0115
393	44	27.5-3	15.5-2	2.0-1	2.0	5.6	11	240	.7018	.2981	.0062
394	44	27.5-3	15.5-2	2.0-1	2.0	8	16	240	.....	.....	.....
395	44	27.5-3	15.5-2	2.0-1	2.0	11	22	240	.....	.....	.....
396	44	27.5-3	15.5-2	2.0-1	2.0	16	32	240	.....	.....	.....
397	45	27.5-3	20.1-1	2.0-1	2.0	1.4	2.8	480	.5981	.2568	.0425
398	45	27.5-3	20.1-1	2.0-1	2.0	1.4	2.8	240	.6083	.2578	.0347
399	45	27.5-3	20.1-1	2.0-1	2.0	2	4	240	.6302	.2657	.0322
400	45	27.5-3	20.1-1	2.0-1	2.0	2.8	5.6	240	.6585	.2754	.0289
401	45	27.5-3	20.1-1	2.0-1	2.0	4	8	240	.6776	.2876	.0199
402	45	27.5-3	20.1-1	2.0-1	2.0	5.6	11	240	.6975	.3023	.0113
403	45	27.5-3	20.1-1	2.0-1	2.0	8	16	240	.6949	.3050	.0029
404	45	27.5-3	20.1-1	2.0-1	2.0	11	22	240	.....	.....	.....
405	45	27.5-3	20.1-1	2.0-1	2.0	16	32	240	.....	.....	.....

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges: Magenta	Wedges: Yellow	Wedges: Cyan	Wedges: Neutral	f-stop: Indicated	f-stop: Actual	Capacitance	Chromaticity Data: x	Chromaticity Data: y	Chromaticity Data: L
406	46	27.5-3	2.0-1	2.0-1	2.0	1.4	2.8	480	.5410	.2633	.0775
407	46	27.5-3	2.0-1	2.0-1	2.0	1.4	2.8	240	.5823	.2519	.0437
408	46	27.5-3	2.0-1	2.0-1	2.0	2	4	240	.6041	.2548	.0366
409	46	27.5-3	2.0-1	2.0-1	2.0	2.8	5.6	240	.6207	.2581	.0314
410	46	27.5-3	2.0-1	2.0-1	2.0	4	8	240	.6137	.2563	.0218
411	46	27.5-3	2.0-1	2.0-1	2.0	5.6	11	240	.6129	.2626	.0117
412	46	27.5-3	2.0-1	2.0-1	2.0	8	16	[illegible]	.6186	.2730	.0035
413	46	27.5-3	2.0-1	2.0-1	2.0	11	22	240	.7307	.2693	.0001
414	46	27.5-3	2.0-1	2.0-1	2.0	16	32	240	.....	.....	.....
415	47	27.5-3	2.0-1	18.7-1	2.0	1.4	2.8	480	.5554	.2607	.0675
416	47	27.5-3	2.0-1	18.7-1	2.0	1.4	2.8	240	.5878	.2526	.0422
417	47	27.5-3	2.0-1	18.7-1	2.0	2	4	240	.6000	.2506	.0328
418	47	27.5-3	2.0-1	18.7-1	2.0	2.8	5.6	240	.5929	.2458	.0235
419	47	27.5-3	2.0-1	18.7-1	2.0	4	8	240	.5711	.2420	.0126
420	47	27.5-3	2.0-1	18.7-1	2.0	5.6	11	240	.5245	.2279	.0043
421	47	27.5-3	2.0-1	18.7-1	2.0	8	16	240	.7309	.2691	.0001
422	47	27.5-3	2.0-1	18.7-1	2.0	11	22	240	.....	.....	.....
423	47	27.5-3	2.0-1	18.7-1	2.0	16	32	240	.....	.....	.....
424	48	27.5-3	2.0-1	12.4-2	2.0	1.4	2.8	480	.5688	.2513	.0487
425	48	27.5-3	2.0-1	12.4-2	2.0	1.4	2.8	240	.5636	.2386	.0265
426	48	27.5-3	2.0-1	12.4-2	2.0	2	4	240	.5054	.2139	.0131
427	48	27.5-3	2.0-1	12.4-2	2.0	2.8	5.6	240	.3956	.1664	.0052
428	48	27.5-3	2.0-1	12.4-2	2.0	4	8	240	.2066	.0860	.0009
429	48	27.5-3	2.0-1	12.4-2	2.0	5.6	11	240	.....	.....	.....
430	48	27.5-3	2.0-1	12.4-2	2.0	8	16	240	.....	.....	.....
431	48	27.5-3	2.0-1	12.4-2	2.0	11	22	240	.....	.....	.....
432	48	27.5-3	2.0-1	12.4-2	2.0	16	32	240	.....	.....	.....

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capacitance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
433	49	27.5-3	2.0-1	10.8-3	2.0	1.4	2.8	480	.1442	.0562	.0013
434	49	27.5-3	2.0-1	10.8-3	2.0	1.4	2.8	240	.....	.....	.....
435	49	27.5-3	2.0-1	10.8-3	2.0	2	4	240	.....	.....	.....
436	49	27.5-3	2.0-1	10.8-3	2.0	2.8	5.6	240	.....	.....	.....
437	49	27.5-3	2.0-1	10.8-3	2.0	4	8	240	.....	.....	.....
438	49	27.5-3	2.0-1	10.8-3	2.0	5.6	11	240	.....	.....	.....
439	49	27.5-3	2.0-1	10.8-3	2.0	8	16	240	.....	.....	.....
440	49	27.5-3	2.0-1	10.8-3	2.0	11	22	240	.....	.....	.....
441	49	27.5-3	2.0-1	10.8-3	2.0	16	32	240	.....	.....	.....
442	50	27.5-3	2.0-1	27.5-3	2.0	1.4	2.8	480	.1380	.0478	.0006
443	50	27.5-3	2.0-1	27.5-3	2.0	1.4	2.8	240	.....	.....	.....
444	50	27.5-3	2.0-1	27.5-3	2.0	2	4	240	.....	.....	.....
445	50	27.5-3	2.0-1	27.5-3	2.0	2.8	5.6	240	.....	.....	.....
446	50	27.5-3	2.0-1	27.5-3	2.0	4	8	240	.....	.....	.....
447	50	27.5-3	2.0-1	27.5-3	2.0	5.6	11	240	.....	.....	.....
448	50	27.5-3	2.0-1	27.5-3	2.0	8	16	240	.....	.....	.....
449	50	27.5-3	2.0-1	27.5-3	2.0	11	22	240	.....	.....	.....
450	50	27.5-3	2.0-1	27.5-3	2.0	16	32	240	.....	.....	.....
451	51	8.3-3	2.0-1	27.5-3	2.0	1.4	2.8	480	.1333	.0650	.0018
452	51	8.3-3	2.0-1	27.5-3	2.0	1.4	2.8	240	.....	.....	.....
453	51	8.3-3	2.0-1	27.5-3	2.0	2	4	240	.....	.....	.....
454	51	8.3-3	2.0-1	27.5-3	2.0	2.8	5.6	240	.....	.....	.....
455	51	8.3-3	2.0-1	27.5-3	2.0	4	8	240	.....	.....	.....
456	51	8.3-3	2.0-1	27.5-3	2.0	5.6	11	240	.....	.....	.....
457	51	8.3-3	2.0-1	27.5-3	2.0	8	16	240	.....	.....	.....
458	51	8.3-3	2.0-1	27.5-3	2.0	11	22	240	.....	.....	.....
459	51	8.3-3	2.0-1	27.5-3	2.0	16	32	240	.....	.....	.....

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac-itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
460	52	15.1-2	2.0-1	27.5-3	2.0	1.4	2.8	480	.3041	.3976	.1090
461	52	15.1-2	2.0-1	27.5-3	2.0	1.4	2.8	240	.1429	.1498	.0101
462	52	15.1-2	2.0-1	27.5-3	2.0	2	4	240	.1307	.0781	.0027
463	52	15.1-2	2.0-1	27.5-3	2.0	2.8	5.6	240	.....	.....	.....
464	52	15.1-2	2.0-1	27.5-3	2.0	4	8	240	.....	.....	.....
465	52	15.1-2	2.0-1	27.5-3	2.0	5.6	11	240	.....	.....	.....
466	52	15.1-2	2.0-1	27.5-3	2.0	8	16	240	.....	.....	.....
467	52	15.1-2	2.0-1	27.5-3	2.0	11	22	240	.....	.....	.....
468	52	15.1-2	2.0-1	27.5-3	2.0	16	32	240	.....	.....	.....
469	53	21.2-1	2.0-1	27.5-3	2.0	1.4	2.8	480	.2231	.3490	.1180
470	53	21.2-1	2.0-1	27.5-3	2.0	1.4	2.8	240	.1684	.2369	.0399
471	53	21.2-1	2.0-1	27.5-3	2.0	2	4	240	.1633	.2011	.0144
472	53	21.2-1	2.0-1	27.5-3	2.0	2.8	5.6	240	.1245	.1039	.0043
473	53	21.2-1	2.0-1	27.5-3	2.0	4	8	240	.....	.....	.....
474	53	21.2-1	2.0-1	27.5-3	2.0	5.6	11	240	.....	.....	.....
475	53	21.2-1	2.0-1	27.5-3	2.0	8	16	240	.....	.....	.....
476	53	21.2-1	2.0-1	27.5-3	2.0	11	22	240	.....	.....	.....
477	53	21.2-1	2.0-1	27.5-3	2.0	16	32	240	.....	.....	.....
478	54	2.0-1	2.0-1	27.5-3	2.0	1.4	2.8	480	.2783	.4098	.2785
479	54	2.0-1	2.0-1	27.5-3	2.0	1.4	2.8	240	.2232	.3698	.1365
480	54	2.0-1	2.0-1	27.5-3	2.0	2	4	240	.1896	.2991	.0574
481	54	2.0-1	2.0-1	27.5-3	2.0	2.8	5.6	240	.1715	.2414	.0251
482	54	2.0-1	2.0-1	27.5-3	2.0	4	8	240	.1722	.2023	.0098
483	54	2.0-1	2.0-1	27.5-3	2.0	5.6	11	240	.....	.....	.....
484	54	2.0-1	2.0-1	27.5-3	2.0	8	16	240	.....	.....	.....
485	54	2.0-1	2.0-1	27.5-3	2.0	11	22	240	.....	.....	.....
486	54	2.0-1	2.0-1	27.5-3	2.0	16	32	240	.....	.....	.....

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac- itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
487	55	2.0-1	20.1-1	27.5-3	2.0	1.4	2.8	480	.2523	.4082	.2280
488	55	2.0-1	20.1-1	27.5-3	2.0	1.4	2.8	240	.2036	.3668	.1044
489	55	2.0-1	20.1-1	27.5-3	2.0	2	4	240	.1766	.3157	.0412
490	55	2.0-1	20.1-1	27.5-3	2.0	2.8	5.6	240	.1595	.2743	.0148
491	55	2.0-1	20.1-1	27.5-3	2.0	4	8	240	.1235	.2342	.0034
492	55	2.0-1	20.1-1	27.5-3	2.0	5.6	11	240	.....	.....	.....
493	55	2.0-1	20.1-1	27.5-3	2.0	8	16	240	.....	.....	.....
494	55	2.0-1	20.1-1	27.5-3	2.0	11	22	240	.....	.....	.....
495	55	2.0-1	20.1-1	27.5-3	2.0	16	32	240	.....	.....	.....
496	56	2.0-1	15.5-2	27.5-3	2.0	1.4	2.8	480	.2914	.5957	.0909
497	56	2.0-1	15.5-2	27.5-3	2.0	1.4	2.8	240	.2743	.6138	.0267
498	56	2.0-1	15.5-2	27.5-3	2.0	2	4	240	.2776	.6212	.0072
499	56	2.0-1	15.5-2	27.5-3	2.0	2.8	5.6	240	.....	.....	.....
500	56	2.0-1	15.5-2	27.5-3	2.0	4	8	240	.....	.....	.....
501	56	2.0-1	15.5-2	27.5-3	2.0	5.6	11	240	.....	.....	.....
502	56	2.0-1	15.5-2	27.5-3	2.0	8	16	240	.....	.....	.....
503	56	2.0-1	15.5-2	27.5-3	2.0	11	22	240	.....	.....	.....
504	56	2.0-1	15.5-2	27.5-3	2.0	16	32	240	.....	.....	.....
505	57	2.0-1	9.4-3	27.5-3	2.0	1.4	2.8	480	.2597	.5534	.0181
506	57	2.0-1	9.4-3	27.5-3	2.0	1.4	2.8	240	.....	.....	.....
507	57	2.0-1	9.4-3	27.5-3	2.0	2	4	240	.....	.....	.....
508	57	2.0-1	9.4-3	27.5-3	2.0	2.8	5.6	240	.....	.....	.....
509	57	2.0-1	9.4-3	27.5-3	2.0	4	8	240	.....	.....	.....
510	57	2.0-1	9.4-3	27.5-3	2.0	5.6	11	240	.....	.....	.....
511	57	2.0-1	9.4-3	27.5-3	2.0	8	16	240	.....	.....	.....
512	57	2.0-1	9.4-3	27.5-3	2.0	11	22	240	.....	.....	.....
513	57	2.0-1	9.4-3	27.5-3	2.0	16	32	240	.....	.....	.....

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges: Magenta	Wedges: Yellow	Wedges: Cyan	Wedges: Neutral	f-stop: Indicated	f-stop: Actual	Capacitance	Chromaticity Data: x	Chromaticity Data: y	Chromaticity Data: L
514	58	2.0-1	27.5-3	27.5-3	2.0	1.4	2.8	480	.2886	.5965	.0075
515	58	2.0-1	27.5-3	27.5-3	2.0	1.4	2.8	240	.....	.....	.....
516	58	2.0-1	27.5-3	27.5-3	2.0	2	4	240	.....	.....	.....
517	58	2.0-1	27.5-3	27.5-3	2.0	2.8	5.6	240	.....	.....	.....
518	58	2.0-1	27.5-3	27.5-3	2.0	4	8	240	.....	.....	.....
519	58	2.0-1	27.5-3	27.5-3	2.0	5.6	11	240	.....	.....	.....
520	58	2.0-1	27.5-3	27.5-3	2.0	8	16	240	.....	.....	.....
521	58	2.0-1	27.5-3	27.5-3	2.0	11	22	240	.....	.....	.....
522	58	2.0-1	27.5-3	27.5-3	2.0	16	32	240	.....	.....	.....
523	59	2.0-1	27.5-3	10.8-3	2.0	1.4	2.8	480	.5206	.4649	.1051
524	59	2.0-1	27.5-3	10.8-3	2.0	1.4	2.8	240	.4674	.5083	.0655
525	59	2.0-1	27.5-3	10.8-3	2.0	2	4	240	.4083	.5544	.0376
526	59	2.0-1	27.5-3	10.8-3	2.0	2.8	5.6	240	.3535	.5858	.0153
527	59	2.0-1	27.5-3	10.8-3	2.0	4	8	240	.2789	.6039	.0032
528	59	2.0-1	27.5-3	10.8-3	2.0	5.6	11	240	.....	.....	.....
529	59	2.0-1	27.5-3	10.8-3	2.0	8	16	240	.....	.....	.....
530	59	2.0-1	27.5-3	10.8-3	2.0	11	22	240	.....	.....	.....
531	59	2.0-1	27.5-3	10.8-3	2.0	16	32	240	.....	.....	.....
532	60	2.0-1	27.5-3	12.4-2	2.0	1.4	2.8	480	.5579	.4323	.1982
533	60	2.0-1	27.5-3	12.4-2	2.0	1.4	2.8	240	.5634	.4264	.1641
534	60	2.0-1	27.5-3	12.4-2	2.0	2	4	240	.5636	.4265	.1493
535	60	2.0-1	27.5-3	12.4-2	2.0	2.8	5.6	240	.5404	.4340	.1220
536	60	2.0-1	27.5-3	12.4-2	2.0	4	8	240	.5295	.4566	.0812
537	60	2.0-1	27.5-3	12.4-2	2.0	5.6	11	240	.5128	.4699	.0393
538	60	2.0-1	27.5-3	12.4-2	2.0	8	16	240	.4917	.4844	.0115
539	60	2.0-1	27.5-3	12.4-2	2.0	11	22	240	.4675	.4976	.0021
540	60	2.0-1	27.5-3	12.4-2	2.0	16	32	240	.....	.....	.....

Table 5 (cont.)

Cal. No.	Exposure Series	Wedges				f-stop		Capac- itance	Chromaticity Data		
		Magenta	Yellow	Cyan	Neutral	Indicated	Actual		x	y	L
541	61	2.0-1	27.5-3	18.7-1	2.0	1.4	2.8	480	.5534	.4360	.2317
542	61	2.0-1	27.5-3	18.7-1	2.0	1.4	2.8	240	.5608	.4289	.1835
543	61	2.0-1	27.5-3	18.7-1	2.0	2	4	240	.5636	.4268	.1622
544	61	2.0-1	27.5-3	18.7-1	2.0	2.8	5.6	240	.5627	.4276	.1616
545	61	2.0-1	27.5-3	18.7-1	2.0	4	8	240	.5658	.4248	.1448
546	61	2.0-1	27.5-3	18.7-1	2.0	5.6	11	240	.5617	.4287	.1071
547	61	2.0-1	27.5-3	18.7-1	2.0	8	16	240	.5654	.4244	.0559
548	61	2.0-1	27.5-3	18.7-1	2.0	11	22	240	.5660	.4219	.0231
549	61	2.0-1	27.5-3	18.7-1	2.0	16	32	240	.5711	.4156	.0060

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DOCUMENT CONTROL DATA

1. ORIGINATING ACTIVITY THE RAND CORPORATION	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP

3. REPORT TITLE

A DISPLAY SIMULATOR FOR COLORED-IMAGE PRESENTATION

4. AUTHOR(S) (Last name, first name, initial)

Stratton, R. H.

5. REPORT DATE	6a. TOTAL No. OF PAGES	6b. No. OF REFS.
December 1966	94	9

7. CONTRACT OR GRANT No.	8. ORIGINATOR'S REPORT No.
SD-79	RM-5015-ARPA

9a AVAILABILITY/ LIMITATION NOTICES	9b. SPONSORING AGENCY
DDC-1	Advanced Research Projects Agency

10. ABSTRACT

Description of a display simulator that tests the ability of human observers to discriminate color differences among widely spaced moving images. The simulator is designed to show on a viewing screen one or more images, the individual size, shape, color, brightness, and position of which may be accurately controlled and varied with respect to real time.

11. KEY WORDS

Vision
Photography
Color
Simulation
Bio-engineering